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**THE EFFECT OF VIRTUAL CLINICAL GAMING SIMULATIONS ON STUDENT  
LEARNING OUTCOMES IN MEDICAL-SURGICAL NURSING EDUCATION  
COURSES**

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Dissertation submitted to the faculty of the  
Marshall University Graduate College  
in partial fulfillment of the requirements  
for the degree of

Doctor of Education  
in  
Curriculum and Instruction

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Huntington, West Virginia, 2009

Keywords: Gaming, Simulation, Nurses, Nursing Education, Learning Strategies

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## **ABSTRACT**

### **The Effect of Virtual Clinical Gaming Simulations on Student Learning Outcomes in Medical-Surgical Nursing Education Courses**

The purpose of this study was to determine what the effects of virtual clinical simulation instruction were on the learning outcomes of students in higher education medical-surgical nursing education courses. This study fills a gap in the literature by adding data to the body of knowledge related to the use of this strategy for practical application in the classroom. This study used a causal comparative design. Data were acquired from the ATI Content Mastery Series (CMS) 2.1 Medical Surgical Examination <sup>TM</sup> information for the fall 2006 through fall 2008 academic semesters. Additionally, data were collected using a pre- and post-course Medical-Surgical Nursing Self-Assessment Survey administered to the medical-surgical virtual clinical simulation comparison group during the fall 2008 semester. Participants were higher education undergraduate medical-surgical nursing students at one urban private university enrolled during the 2008-2009 academic year. Students were fluent English speakers and had a grade point average (GPA) of 2.5 or greater in nursing coursework. Participation in the survey was voluntary. Benefits of the research included positive effects of using virtual clinical simulation to deliver medical-surgical nursing content. Findings revealed that students who received virtual clinical simulation instruction significantly demonstrated ( $p = .000$ ) for medical-surgical content mastery and 100% of students demonstrated positive growth ( $p = .000$ ) in perceived competency. Results empower nursing stakeholders such as administrators, program chairs, faculty, and students with information for decision-making about learning outcomes, limitations, and recommendations related to the use of virtual clinical simulations in medical-surgical nursing education courses.

## **DEDICATION**

This work is dedicated to professional nursing educators who strive to create enjoyable learning in the classroom using innovative virtual clinical simulation instruction integrated with multimedia technology preferred by today's digital native students. Using virtual clinical simulations for nursing process application with didactic material provides increased student experiences during training independent of instructor and clinical site availability. Lastly, I dedicate this study to the University of Charleston professional nurse graduating class of 2009 for volunteering then demonstrating achievement and competence in medical-surgical nursing content mastery with virtual clinical simulation instruction.

## **ACKNOWLEDGEMENTS**

Without the influence, guidance, dedication, scholarship, and service of the doctoral faculty of the Marshall University Graduate School of Education and Professional Development at South Charleston, West Virginia, this dissertation research study would not have been imagined or possible.

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To Dr. Rudy Pauley I want to convey my appreciation for your influence as an educational leader and practitioner. Through your innovative words and deeds, you demonstrate that technology integration in curriculum can promote learning for understanding from communication, collaboration, and problem solving that is fun and creative.

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research course, you made learning the connection between research design and appropriate statistical decision-making interactive and enjoyable. Thank you for demonstrating an effective teaching model for simulation instruction in the classroom.

To Dr. David L. Rodgers I wish to extend my thankfulness to you for being a role model for simulation instruction to prepare healthcare providers in realistic settings for future performance during critical health incidents with patients. Your work reveals that simulation provides opportunities for students to practice life-saving measures in safe settings to gain experience that can affect their future performance and ultimately a patients' health.

To my family I extend my gratitude and appreciation for instilling in me the belief that education is a life-long process toward enriched existence and professional practice. The guidance and support I received from the hard work of my parents provided me my first opportunity for a college degree. Thank you to my mom Joyce Lewis for all the sacrifices you made to give me the chance to attain my dream of being a nurse. To my dad who passed away before I reached this milestone I remain thankful for the life lessons that he taught. First, to live each day as if it were a last telling those you love you love them as often as you can. Second, to seize every opportunity to experience the things you love doing. Third, to love yourself by never giving up on your dreams but instead persevering because when all seems lost the time comes when your preparation and circumstance meet and life becomes your dreams.

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## **CHAPTER ONE: INTRODUCTION**

Over the past decade, higher education institutions have undergone reform to integrate technology into instruction (Allen & Seaman, 2006; Brill & Galloway, 2007; Hancock, Bray & Nason, 2002; Vogel & Klassen, 2001). Despite these trends, nursing educators continue to rely on traditional methods of teaching (Henry, 1997; Royse & Newton, 2007). Pleas for educational reform in nursing using innovative strategies and technology that make the teaching/learning process enjoyable while preparing students for a demanding chaotic health care system are emerging (Jefferies, 2007; National Council of State Boards of Nursing [NCSBN], 2006; National League for Nursing [NLN], 2008; Royse & Newton, 2007). The importance of this issue to nursing education exists because today's students are different; they are the Net-Generation (N-Geners) (Tapscott, 1998), known as digital natives (Prensky, 2001a, 2001b), and as such, require changed instructional and assessment strategies (Howell, 2004).

Because today's students are different, nurse educators need awareness of their distinctiveness. Digital natives have grown up with an Internet and digital technology presence throughout their entire lives making them the first digitally literate generation (Howell, 2004; Prensky, 2001a, 2001b; Tapscott, 1998). This unique life experience has yielded developmental differences in learning, thinking, and working (Howell, 2004; Prensky, 2001a, 2001b; Tapscott, 1998).

For instance, digital media has supplied digital natives a platform to explore, socialize, communicate, interact, discover, create, and debate in different ways than previous generations (Tapscott, 1998). Thus, they are characterized as a curious, tolerant, assertive, self-reliant, assured, highly clever, and quarrelsome group (Tapscott, 1998). In addition, digital natives

communicate differently than their predecessors because they use digital resources, to frequently and readily, converse with the world (Howell, 2004; Prensky, 2001a, 2001b; Tapscott, 1998). Increased communication with diverse groups makes them more connected, experiential, social, and service oriented than prior students (Prensky, 2001a, 2001b; Tapscott, 1998). Because digital natives have always had access to and used digital media for communication and information, they anticipate similar experiences for learning and evaluation (Howell, 2004; Prensky, 2001a, 2001b; Tapscott, 1998). Thus, digital natives expect immediacy, structure, engagement, teamwork, and visual and kinesthetic media (Howell, 2004; Prensky, 2001a, 2001b; Tapscott, 1998). Since digital natives as learners are different from previous generations, educational transformation is needed. Therefore, if nursing educators want to teach digital native students effectively, they need to reform their practice with innovative instructional strategies that integrate digital media and technology.

## **Background**

### ***Nursing Education***

Historically, since the first university nursing education program at Yale University in 1923, nursing educators have predominantly used traditional instructional methods of lecture in university classrooms, reserving experiential methods for clinical settings (Aranda, 2007; Henry, 1997; Royse & Newton, 2007; Schmitz, MacLean, & Shidler, 1991). This phenomenon is related to the profession of nursing evolving from an applied vocation in bedside and hospital apprenticeships to a professional discipline in higher education institutions (Aranda, 2007). The approach of separating didactic content and clinical situations in current university settings results in a delay of practical application of realistic nursing care for students. Furthermore, the nature of clinical experience in hospital settings is dependent upon the care needs of available

patients and the availability of an instructor to provide safe opportunities for the student to practice nursing care functions (Larew, Lessans, Spunt, Foster & Covington, 2006). Nursing education reform directed at increasing realistic practical experience in the classroom would decrease time delays between didactic and practical application as well as eliminate patient and instructor availability barriers for nursing student experiences.

To increase realistic practical application in objective, safe environments, some higher education institutions have integrated digital media and technology into instruction (Allen & Seaman, 2006; Brill & Galloway, 2007; Hancock et al., 2002; Larew et al., 2006; Vogel & Klassen, 2001). Currently, technology is thought to be “the practical application of knowledge... [and]...a capability given by the practical application of knowledge” (Technology, 2008, ¶ 1). Thus, technology is the use of digital media integrated as either an antecedent or consequence to practical or experiential learning in the classroom. Simply stated, technology integration in nursing education is an instructional strategy to transform educational delivery with applied methods.

Though colleges and universities have begun educational reform to integrate technology into instruction, the discipline of nursing is lagging in the adoption of technology for practical application in the classroom, creating barriers for adult learners who prefer doing an action while simultaneously hearing and seeing how it is done (Ward & O’Brien, 2005). However, pleas for educational reform in nursing to incorporate digital media that provides instruction that is more realistic are emerging (Barber & Norman, 1989; Barnes & Rudge, 2005; Jefferies, 2007; Mallow & Gilje, 1999; NCSBN, 2006; Nehring, Ellis, & Lashley, 2001; Nehring & Lashley, 2004; NLN, 2001; Royse & Newton, 2007; Sauv , Renaud, Kaufmann, & Marquis,

2007). The innovative teaching strategy of virtual clinical simulation instruction applied with educational gaming software is an option to meet this need.

### ***Instructional Methods***

A game is defined as an “artificial situation in which players, put in a conflict with one another or against other forces, are governed by rules that structure their actions in order to meet learning objectives and a goal determined by the game” (Sauvé et al., 2007, p. 251).

Gaming refers to simulation or reenactment of “real-life” activities containing the element of realism (Tashiro, 2006). Simulation is an instruction and evaluation method in which students practice “tasks and processes in ...[realistic]... circumstances using models or virtual reality, with feedback from observers, peers, actor-patients and video cameras to ...[develop]... skills” (Eder-Van Hook, 2004, p. 4). For this study, gaming and simulation are synonymous terms used to represent an instructional method that incorporates practice, experience, and feedback for knowledge construction in real-world situations using digital media.

Virtual clinical gaming simulations are a form of digital media instruction designed to provide realistic interactive patient care scenarios for learning with educational gaming software (Tashiro, 2006). Practice disciplines like sociology (Petranek, 2000) and medicine (Agazio, Pavlides, Lasome, Flaherty, & Torrance, 2002; Eder-Van Hook, 2004) use gaming simulation instruction in classroom and clinical laboratories to integrate content with application. However, nursing has been slow to adopt gaming simulation instruction though the method is suitable for adult learners when the goal is to construct knowledge from doing (Henry, 1997; Morton, 1997; Walljasper, 1982; Ward & O’Brien, 2005).

Reluctance in nursing to implement gaming simulation instruction may be linked to the limited number of studies reporting on the effectiveness of simulation as a teaching strategy to

enhance student learning (Alinier, Hunt, Gordon, & Harwood, 2006; Ballatine, 2003; Bays & Hermann, 1997). By contrast, adoption of gaming simulation instruction by nurse educators may also be hampered by empirical findings that demonstrate similar student performance between traditional and gaming simulation instruction, or that there is no statistical difference in student achievement for traditional instruction compared to gaming simulation instruction. For instance, no statistical difference was found between conventionally instructed students and gaming simulation instructed students on their ability to generate hypotheses and learn issues in nursing problem-based learning (PBL) courses (Ingram, Ray, Landeen, & Keane, 1998). Additionally, traditional instruction was found to be more effective than gaming simulation instruction ( $p = .000$ ) for student achievement on immediate recall of geriatric concepts (Montpas, 2004).

### ***Learning Theory***

Theoretical discussions about digital media virtual clinical gaming simulations for learning in nursing are evolving. The perspectives of adult learning theory, chaos theory, cognitive load theory, and constructivism support the integration of digital media into instruction (De Miranda, 2004; Hmelo-Silver, 2004; Henry, 1997; Leigh & Spindler, 2004; Lewis, Saydak, Mierzwa & Robinson, 1989; Paas, Tuovinen, Tabbers, & Van Gerven, 2003; Peters, 2000; Spigner-Littles & Anderson, 1999; Vogel & Klassen, 2001; Ward & O'Brien, 2005).

Proponents of adult learning theory contend that adult learners are self-motivated, self-directed individuals who prefer learning that involves active participation, practical experience, and real-world problem solving (Henry, 1997; Knowles, 1979; Lewis et al., 1989; Ward & O'Brien, 2005). Thus, digital media instructional strategies that incorporate these components

are appropriate for adult learners. The instructional strategy of virtual clinical gaming simulation uses digital media instruction created to provide realistic interactive patient care scenarios that prompt users to apply the nursing process of assessment, diagnosis, outcome identification, planning, implementation, and evaluation to problem-solve clinical situations in a virtual hospital (Tashiro, 2006). Therefore, the use of virtual clinical gaming simulation is an appropriate instructional strategy for adult learners who have been introduced to the nursing process within nursing curriculum (Ward & O'Brien, 2005).

Chaos theory promoters suggest that direction and logic coexist with chaos in dynamic systems (Leigh & Spindler, 2004). Open simulations are virtual experiences representing scenarios created and guided by educators to sensitize or prepare learners for action in patterned chaotic and unpredictable real life settings. Virtual clinical gaming simulations are open simulations of patient care scenarios created to prepare nurses for action in unpredictable healthcare settings through learning to use the structured and logical nursing process in patterned changing patient problems.

The viewpoint from cognitive load theory assumes that humans have a working memory with a limited capacity to apply or transfer acquired information to new situations and an unlimited long-term memory that interacts or processes visual/auditory information to hold schemas that vary in complexity and automation (Paas et al., 2003). Based on this premise, cognitive theorists argue that instruction should be designed with multimedia to be effective and mentally efficient in promoting schema construction and automation.

Additionally, advocates of constructivist learning theory assert the viewpoint that knowledge and learning are constructed through the acts of communication, collaboration, and problem solving in real-world settings (Hmelo-Silver, 2004; Spigner-Littles & Anderson, 1999;



Vogel & Klassen, 2001). Constructivists believe that learning occurs best through practical application and doing that builds upon prior knowledge (Hmelo-Silver, 2004; Spigner-Littles & Anderson, 1999; Vogel & Klassen, 2001). Virtual clinical gaming simulations are rich with digital media such as sounds, video clips, and visual cues to engage learners actively in realistic patient care scenarios (Tashiro, 2006). Furthermore, virtual clinical gaming simulations require students to solve patient problems, applying previously learned nursing actions through collaboration and communication with virtual actors (i.e., patients, other healthcare professionals, and peers) within the game or simulation (Tashiro, 2006). Thus, virtual clinical gaming simulations are suitable instructional strategies to use with nursing students in constructivist classrooms.

### ***Student Characteristics***

Modern adult student learners differ from previous generations. Contemporary higher education students, characterized as digital natives (Howell, 2004; Prensky, 2001a, 2001b; Tapscott, 1998), are the first generation to develop encircled by and using digital technology (i.e., Internet, computers, videogames, etc.) their entire lives. Digital natives have grown up in a digital media environment so their experiences differ from previous generations. Physicians, neuroscientists, psychologists, and psychiatrists contend that if an individual has exposure to different types of experiences it will lead to changed brain structures, functioning, and processing (Farah et al., 2008; Greenough, Black, & Wallace, 1987; Grossman et al., 2003; Hammock, 2006; Heidelise et al., 2004; Prensky, 2001a, 2001b; Wilkinson, 2004). Because digital natives have had the distinct experience of digital media exposure throughout life, their brain makeup is unlike their predecessors; they think and process information differently (Howell, 2004; Prensky, 2001a, 2001b; Tapscott, 1998). A changed student population in

higher education prompts educational reform. College and university educators must empower themselves with knowledge of digital native characteristics so they can implement educational strategies appropriate for this new type of student.

Digital natives are the group of students who have always had access to a commercial Internet, launched in the United States (US) in 1992, and who have always used digital technology in a digital world (Howell, 2004; Prensky, 2001a, 2001b; Tapscott, 1998). For everyone else “not born into the digital world but have, at some later point ... become fascinated by and adopted many or most aspects of new technology are, and always will be ...digital immigrants” (Prensky, 2001a, p. 2).

The important difference between these two groups is in the way they obtain information. For example, digital immigrants always “retain to some degree their ‘accent’, that is their foot in the past” (Prensky, 2001a, p. 2). “Digital immigrant assertion... [is exemplified in actions such as]...turning to the Internet second rather than first... [for information]... or in reading the manual for a program rather than assuming that the program itself will teach us to use it” (p. 2). Thus, digital immigrants prefer to gain knowledge similar to their life experiences in a digital free world, seriously, slowly, in sequenced steps from text and lectures (Prensky, 2001a). By contrast, digital natives desire to receive information and be evaluated the way they have acquired information from their experiences with and using digital media first, and for nearly everything, including entertainment, communication, collaboration, and learning (Howell, 2004; Prensky, 2001a, 2001b; Tapscott, 1998). Digital natives prefer learning playfully, quickly, in multitasking situations from graphics, audio and multimedia games (Prensky, 2001a; Tapscott, 1998).

Learning preferences of digital natives are elucidated further by the account that “today’s average college grads have spent less than 5,000 hours of their lives reading, but over 10,000 hours playing video games” (Prensky, 2001a, p.1). In other words, digital natives favor interactive hands on methods like multimedia gaming experiences for acquiring information over traditional passive methods like reading. Therefore, higher education faculty who use innovative multimedia and gaming strategies for instruction, compared to traditional teaching approaches, facilitate the fun and interactive learning environments preferred by digital native students for knowledge achievement.

### ***Achievement***

Achievement of knowledge or content mastery in nursing has traditionally been measured by objective written examinations (Davenport, 2007; Jacobs & Koehn, 2006; Mosser, Williams, & Wood, 2006; Newman & Williams, 2003; Rushton & Eggett, 2003; Seldomridge & DiBartolo, 2004). For instance, all professional nurses in the US must be licensed to practice. Licensure is obtained after student nurse candidates take and pass the National Council Licensure Examination for Registered Nurses (NCLEX-RN<sup>®</sup>) that is developed by the National Council of State Boards of Nursing, Inc. (NCSBN). The NCLEX-RN<sup>®</sup> measures student competencies essential in meeting health needs of patients (Assessment Technologies Institute [ATI], 2004; NCSBN, 2004). Schools of nursing are currently measuring student mastery and competence of NCLEX-RN<sup>®</sup> content by using standardized tests such as those marketed by Assessment Technologies Institute (ATI), LLC (ATI, 2008). Standardized exams are independently developed using the NCLEX-RN<sup>®</sup> Test Plan, and provide the student and school a way to measure student readiness objectively for NCLEX-RN<sup>®</sup> success (ATI, 2008; Jacobs &

Koehn, 2006; NCSBN 2004). NCLEX-RN<sup>®</sup> achievement signifies that graduates have the competence needed for entry-level practice (NCSBN, 2004).

## *Competence*

Competence encompasses a combination of the knowledge, skills, and behavior that a professional needs to have the ability to perform a specific role (Competence, 2008; Competence, n.d.; U.S. Department of Education, 2002). Accordingly, competence is complex requiring multiple strategies for assessment and promotion (Piercey, 1995; Redfern, Norman, Calman, Watson & Murrells, 2002; Sifford & McDaniel, 2007; Slezak & Saria, 2006; Yaeger et al., 2004). Consumers of an ever-changing US healthcare delivery system have mandated that schools of nursing provide students with current and practical learning to achieve competency in the professional nursing role (Pew Health Professions Commission, 1998). Furthermore, nursing graduates are unable to practice in the role as a professional nurse until their nursing competence is assessed by the standardized NCLEX-RN<sup>®</sup> and licensure is granted upon passing (NCSBN, 2004). Thus, while students are enrolled in nursing programs, schools of nursing use the NCLEX-RN<sup>®</sup> Test Plan, a concise summary of the content and scope of NCLEX-RN<sup>®</sup>, to determine students' competency needs for the professional nursing role (NCSBN, 2004, 2007).

Currently, the NCLEX-RN<sup>®</sup> Test Plan lists four major client need categories tested on the NCLEX-RN<sup>®</sup> (NCSBN, 2004, 2007). The client need categories are safe and effective care, health promotion and maintenance, psychosocial integrity, and physiological integrity. Within the client need categories, the specific competence needs of students are established. For instance, the medical-surgical competency knowledge and skills that students' need for caring for clients with altered health states is located within the physiological integrity category. Therefore, self-reported data collection measures that include information from the physiological integrity category of the NCLEX-RN<sup>®</sup> blueprint provides information on

students' perceived competence in the medical-surgical content needed for beginning level practice in caring for clients with altered health states that is tested on the NCLEX-RN®. However, obtaining self-reported information from students using a numerical scale about their competence on medical-surgical content from the NCLEX-RN® Test Plan only provides a general evaluation. If depth or insight is sought about a subject or event, then qualitative techniques like interviewing or opinion questioning that seek non-numerical or verbal data should be used (AQR: The Association for Qualitative Research, 2008). Although, if a nationally normed instrument such as the Assessment Technologies Institute Content Mastery Series 2.1 Medical Surgical Exam™ (ATI CMS 2.1 MS Exam™), (ATI, 2008) is used, that is developed from the NCLEX-RN® Test Plan (NCSBN, 2004), then it can provide a standardized objective measure of student readiness in specific content areas measured on the NCLEX-RN® (Jacobs & Koehn, 2006).

### **Problem Statement**

Today's nursing students are different than previous generations. They are adult learner digital natives who prefer learning similar to the way they have obtained information throughout their entire lives, interactively, using digital technology that is enriched with audio, visual and kinesthetic media. The instructional strategy of virtual clinical gaming simulation is an innovative computer-assisted teaching method that integrates media and technology into instruction with software to create content specific realistic patient care scenarios for practical experience application use in medical-surgical course classrooms and laboratories. Research on the use of gaming simulation instruction to educate nurses is limited and a gap in evidence exists on the use of virtual clinical gaming simulation instruction to deliver content in medical-surgical courses where no studies could be located. Medical-surgical content mastery is

essential for nursing graduate readiness for entry-level professional practice determined by successful performance on the high stakes exam known as NCLEX-RN<sup>®</sup>. Because nursing program accreditation and graduate licensure is connected to student success on NCLEX-RN<sup>®</sup>, schools of nursing are using nationally normed instruments like the ATI CMS 2.1 MS Exam<sup>™</sup> developed from the NCLEX-RN<sup>®</sup> Test blueprint to provide standardized objective measures to determine student readiness in the specific content areas measured on the NCLEX-RN<sup>®</sup>. Therefore, research investigating the use of gaming simulation instruction to deliver essential medical-surgical content for entry level nursing practice assessed on the high stakes NCLEX-RN<sup>®</sup> in courses provides new information to nursing education stakeholders charged with decision-making on adoption of its use.

### **Purpose of the Study**

Research studies have reason. The purpose of this study is to determine if the use of the instructional strategy of virtual clinical gaming simulation to deliver medical-surgical content has an effect on the learning outcomes of students in higher education medical-surgical nursing education courses.

### **Research Questions**

The research questions addressed in this quantitative study are as follows:

1. What are the differences in post-instruction exam achievement scores on the Assessment Technologies Institute Content Mastery Series 2.1 Medical-Surgical Exam<sup>™</sup> among higher education medical-surgical nursing students taught with and without virtual clinical simulation instruction during the fall of 2006 through the fall of 2008 semesters?

2. What are the differences in pre/post-instruction exam achievement scores on the Assessment Technologies Institute Content Mastery Series 2.1 Medical-Surgical Exam™ among higher education medical-surgical nursing students taught with and without virtual clinical simulation instruction during the fall 2008 semester?
3. What are the differences in pre/post-instruction perceived competence summative scores on the Medical-Surgical Nursing Self-Assessment Survey among higher education medical-surgical students who received virtual clinical simulation instruction during the fall 2008 semester?

### **Definition of Terms**

To clarify the meaning of terms and concepts used in this study, the following definitions are provided:

1. Virtual clinical simulation - A form of digital media instruction using software designed to provide realistic interactive patient care scenarios for learning that prompts users to problem-solve clinical situations in a virtual hospital setting. For this study, the specific educational software used to implement this application was Virtual Clinical Excursions (VCE) 3.0, by Elsevier, Inc. (Evolve®, 2008). VCE is computer-based interactive partial virtual reality clinical simulations delivered in 2D using a computer screen, speakers, mouse and printer stimulating participant hearing and vision.
2. Assessment Technologies Institute Content Mastery Series 2.1 Medical-Surgical Exam™ (ATI CMS 2.1 MS Exam™) - A standardized nationally normed medical-surgical content instrument developed by Assessment Technologies Institute, LLC (ATI), using the NCLEX-RN® Test Plan to assess nursing student mastery of medical-surgical content assessed on NCLEX-RN® to provide nursing education stakeholders an



objective measure for determining student readiness for entry level professional nursing practice with medical-surgical patients.

3. Medical-Surgical Nursing Self-Assessment Survey (Appendix B) - A researcher developed demographic and competence level tool created from relevant literature and the NCLEX-RN® Test Plan and validated by a panel of content experts (Appendix C) to assess higher education medical-surgical students' self-reported characteristics and current level of skill in medical-surgical nursing practice.

### **Operational Definitions**

For the purpose of this study, the following operational definitions are used:

1. Achievement - Student composite scores on the Assessment Technologies Institute Content Mastery Series 2.1 Medical-Surgical Exam™.
2. Students - Higher education students enrolled in medical-surgical nursing courses from the associate and baccalaureate degree nursing programs at one private university who participated in this study by completing the Assessment Technologies Institute Content Mastery Series 2.1 Medical-Surgical Exam™ and/or the Medical-Surgical Nursing Self-Assessment Survey.
3. Instructional method - Two instructional methods were used in this study: multimedia enriched virtual clinical simulation instruction (VCSI) using virtual clinical gaming simulation software to create practical application patient experiences in the classroom to deliver medical-surgical content in conjunction with facilitated discussion and lecture versus traditional instruction (TI) for medical-surgical content delivered with facilitated discussion and lecture with no use of virtual clinical gaming simulation software.

4. Pre/post self-report survey - The researcher developed Medical-Surgical Nursing Self-Assessment Survey used to assess higher education medical-surgical students' self-reported characteristics and current level of skill in medical-surgical nursing practice before and after medical-surgical content instruction.
5. Perceived competence - Students self-reported medical-surgical nursing practice level summated scores, on 20 items on the Medical-Surgical Nursing Self-Assessment Survey, based on a rating scale of 1 = none, 2 = low competence, 3 = moderately low competence, 4 = moderately high competence, and 5 = high competence.

### **Significance of the Study**

This study fills a gap in nursing education literature. No studies were located reporting on the effects of virtual clinical gaming simulation instruction on the learning outcomes of students in medical-surgical nursing education courses. Thus, a consequence of this inquiry is quantitative data is added to the body of knowledge related to the effects on achievement and competence of students when medical-surgical content specific computer-assisted multimedia enriched partial reality virtual clinical gaming simulation software is used as an instructional strategy for practical applications in medical-surgical nursing classrooms.

Results from this study provide new evidence for nursing education stakeholders consisting of accreditors, administrators, program chairs, faculty, students, educational software designers, standardized nursing content examination developers, textbook publishers, patients, and researchers to use for decision-making with gaming simulation instruction. For instance, accreditors can use the data when creating standards and recommendations for instructional delivery practices for nursing education. Administrators and program chairs can employ the evidence when supporting, verifying or denying departmental budget needs for equipment

purchases and faculty/staff development related to multimedia gaming simulation instruction. Accreditors, administrators, faculty, students, and patients can use the information when determining evaluation methods to assess nursing graduate readiness for entry-level medical-surgical patient practice. Faculty and students can use the data when choosing interactive digital media instruction methods that are congruent with learning preferences of today's digital native higher education medical-surgical nursing students. Educational software designers, standardized nursing content examination developers, and textbook publishers can use this evidence when establishing needs for continued and future development of specific nursing content gaming simulation software products. Lastly, researchers can use the information from this study to determine results, limitations, and recommendations related to the use of virtual clinical simulation instruction for nursing education for future investigations.

### **Assumptions**

An assumption is defined as a fact or proposition that is taken for granted as if it were known to be true (Assumption, 2008). This study assumes that the National League for Nursing Accrediting Commission, Inc., (NLNAC) Standards and Criteria for Associate and Baccalaureate Nursing Programs is representative of the current curriculum goals and student learning outcomes of higher education nursing education providers in the US (National League for Nursing Accrediting Commission [NLNAC], 2008). In addition, this study assumes that the ATI CMS 2.1 MS Exam™ assesses medical-surgical nursing content similar to the NCLEX-RN®. Furthermore, this study assumes that participants honestly and completely answered all of the questions on the Medical-Surgical Nursing Self-Assessment Survey.

### **Limitations of the Study**

Limitations refer to known areas of a study that the researcher lacks control over that may negatively affect the results or the ability to generalize findings (Roberts, 2004). Areas of concern in this study that cannot be controlled for by the researcher are related to the lack of standardization in nursing education in the US.

This study was conducted at one higher education undergraduate accredited nursing school. There are over 1,559 undergraduate associate (ADN) and baccalaureate in nursing (BSN) higher education accredited nursing school programs in the United States (Bureau of Labor Statistics, 2008). Though nursing programs use the NCLEX-RN<sup>®</sup> Test Plan to regulate the appropriate medical-surgical content that students need to master to be prepared for the NCLEX-RN<sup>®</sup>, there is a limitation to generalizing this study to the greater population of higher education medical-surgical nursing education courses nationwide because of the differences in school and program philosophies, objectives, and curricula.

Additionally, the sample size for this study was small and limited to undergraduate higher education medical-surgical nursing students at one institution. Therefore, a limitation of this study is the inability to generalize findings to other groups of nursing students with varying levels of entry-level preparation.

## **CHAPTER TWO: REVIEW OF RELATED LITERATURE**

Examination of the related literature on gaming simulation instruction is the point of this chapter. The purpose of a literature review is to find, analyze, integrate, and interpret previous documents and research to determine what is known and not known about a topic (Roberts, 2004). The information provided expands the discussion of gaming simulation as it relates to nursing education, instructional methods, learning theory, student characteristics, achievement, competence, and opinion.

### **Nursing Education**

Since the beginning of formal nursing education programs in the US, traditional instructional methods of lecture and discussion have been used for didactic nursing material with experiential methods reserved for clinical settings (Henry, 1997; Larew et al., 2006; Nehring et al., 2001; Schmitz et al., 1991; Ward & O'Brien, 2005). This trend of traditional instruction in nursing classrooms relates to the profession's origin of evolving from an applied vocation of bedside and hospital apprenticeship to a formal professional discipline in higher education institutions (Aranda, 2007).

University affiliated nursing education originated at Yale in 1923 with a curriculum that combined on campus coursework with hospital apprenticeships requiring students to meet educational standards to graduate (Aranda, 2007). A separation of classroom and clinical practice prevails in nursing today with one main difference, some of the coursework is now offered via online classrooms (Aranda, 2007). The approach in nursing to separate didactic and patient management experiences contradicts recommendations to provide participation and practical experience opportunities concurrently for adults to foster an environment that matches

their preference for learning (Ballatine, 2003; Ward & O'Brien, 2005). Thus, educational reform that changes nursing curriculum delivery from separated to combined practice and didactic experiences could benefit adult learners.

Pleas for reform in higher education to use innovative instruction integrated with technology and digital media to increase practical applications (Brill & Galloway, 2007) and real world problem-solving into classroom teaching are emerging (Jefferies, 2007; NCSBN, 2006; NLN, 2001). Gaming simulation instruction is a teaching method that incorporates practice, experience, and feedback into realistic situations. Gaming simulation instruction can be applied using virtual reality software (Tashiro, 2006) or realistic models (Eder-Van Hook, 2004). Moreover, when gaming simulation instruction is applied as a virtual clinical simulation it is teaching that uses digital media to provide realistic interactive patient care situations in a virtual clinical or hospital setting for learning (Tashiro, 2006). Thus, virtual clinical gaming simulation instruction integrated with technology is an appropriate way that nurse educators can deliver nursing curriculum combining virtual practice and content. Therefore, knowing how virtual clinical gaming simulation instruction has been explored, described, and researched in nursing education is essential to implementing its use.

Examination of the literature on virtual clinical gaming simulation instruction and nursing education exposed limited information on the method. Findings included two theoretical writings. A theory is “an abstract generalization that presents a systematic explanation about the relationships among phenomena” (Polit & Beck, 2004, p. 734). Analysis of the literature on virtual clinical gaming simulation instruction and nursing education revealed varied theories to explain the associations of connection as it relates to nurse educator preparedness to use and evaluate the method, and to the transformative nature of virtual

environments to nursing practice, located literature is presented (Barber & Norman, 1989; Barnes & Rudge, 2005).

In 1989, Barber and Norman reviewed the literature to determine nurse educators' preparedness to use and evaluate gaming simulation instruction in experiential learning climates and found that more research was needed to explore the effects of gaming simulation on student nurse learning. In addition, Barber and Norman discussed problems of evaluation and determined that nurse educators need to reject classical evaluation founded on learning objectives expressed in behavioral terms in favor "of 'illuminative' evaluation and the approach of 'new paradigm research' " (p. 146). Ultimately, Barber and Norman concluded that teacher preparation for gaming simulation and illuminative evaluation requires therapeutic growth gained from experiencing a similar condition themselves as learners, in a facilitated democratic learning environment with other participants, inquiring and interacting during the event.

Barnes and Rudge (2005) used spatial theories to analyze the literature on the use of virtual environments to coordinate and operate managed care and how nurses interact with these networks. The authors explored the development of virtual reality technologies in nursing and identified a collection consisting of computer networks, databases, information systems, and software programs. Conclusions by the writers implied that virtual technology has prompted a paradigm shift in the discipline from the holistic care of human beings to a reduced focus on fragmented problems because the flow of information and time has moved toward network systems and managed care based on aggregates and averages, and away from individuals. Thus, Barnes and Rudge contend that virtual environments are transformative to nurses influencing practice from the holistic care of humans to the focused care of managed problems prompting scholarly inquiry and research to explore this phenomenon.

Overall investigation of the located literature on virtual clinical gaming simulation instruction and nursing education revealed that published information is limited to two theoretical articles. Therefore, it can be concluded that more work is needed in the discipline, especially theoretical and conceptual frameworks explaining the relationships between virtual clinical gaming simulation teaching and learning, because no articles were found exploring this connection. Additionally, a gap was found in published evidence from research on virtual clinical gaming simulation instruction in nursing education since no studies could be located. Therefore, the discipline could benefit from studies using experimental, quasi-experimental and descriptive designs to build the body of knowledge.

### **Instructional Methods**

Instruction refers to the act, practice, or vocation of teaching (Instruction, 2009). A method is the organized plan followed in delivering information for instruction (Method, 2009). Therefore, an instructional method can be inferred to be a systematic way to deliver content for teaching.

Gaming simulation instruction refers to the organized way instructors transmit material using practical experience with realistic or virtual scenarios (Eder-Van Hook, 2004; Tashiro, 2006). Traditionally, nursing has relied on the time-honored methods of lecture to convey content in the classroom reserving practical applications for clinical laboratories (Henry, 1997; Morton, 1997; Walljasper, 1982; Ward & O'Brien, 2005). However, gaming simulation instruction has been suggested as a way to facilitate practical experiences in conjunction with didactic material delivery in classrooms and clinical laboratories (Agazio, et al., 2002; Eder-Van Hook, 2004; Petranek, 2000; Tashiro, 2006). Therefore, an exploration of the literature on the instructional method of gaming simulation and nursing content was undertaken. No studies



were found reporting on gaming simulation and nursing content using virtual clinical simulation educational gaming software to deliver nursing content. However, overall analysis of the literature on gaming simulation and nursing content revealed that gaming, simulation, and gaming simulation instruction to deliver nursing content using other non-digital and digital media have been studied. Gaming simulation literature is reported.

### ***Gaming Instruction***

Review of the literature on gaming instruction and nursing content resulted in a finding of 15 articles. Overall analysis of gaming instruction literature and nursing content revealed no published studies reporting on digitally enhanced virtual clinical simulation educational gaming software to deliver nursing content. Located articles on non-digital gaming techniques were found and are reported (Bartfay & Bartfay, 1994; Bays & Hermann, 1997; Berbiglia, Goddard, & Littlefield, 1997; Cessario, 1987; Cowen & Tesh, 2002; Gruending, Fenty, & Hogan, 1991; Henry, 1997; Ingram et al., 1998; Kuhn, 1995; Montpas, 2004; Royse & Newton, 2007; Schmitz et al., 1991; Sisson and Becker, 1988; Walljasper, 1982; Ward & O'Brien, 2005).

In 1994, nursing faculty Bartfay and Bartfay conducted a quasi-experimental study to evaluate the effectiveness of using gaming as a strategy for teaching health promotion information related to heart disease and cancer prevention to children. Researchers used a convenience sample of 23 grade-school students from one class in Winnipeg, Manitoba that were randomly selected to a treatment or control group using 12 red tokens and 12 blue tokens. Data collection occurred pre- and post-training by administering a 30-item written examination. Results of the study indicated the differences between pre-test and post-test scores were found to be significant for the treatment group ( $p < .05$ ) of students receiving gaming instruction but not for the control group receiving traditional instruction.

A quasi-experimental study directed by Bays and Hermann (1997) examined the effects of using the teaching technique of gaming on content retention of the endocrine system on a convenience sample of 69 baccalaureate-nursing students enrolled in a medical-surgical nursing course at one urban university. A multiple-choice, single-response, 16-question examination using the same test blueprint, administration and scoring was used for post-test only data collection. The investigators found that groups had similar results or no significant difference on posttest exams ( $p > .05$ ), demonstrating that gaming was as effective as lecture for student learning. However, researchers reported that the groups did differ in comments on interest in the subject content, with the gaming group reporting higher interest than the non-gaming group.

Berbiglia et al. (1997) used the instructional strategy of gaming in a game-show format with 31 baccalaureate-nursing students to deliver course content. Evaluators reported that gaming stimulated group involvement, cooperation, competition, thinking, creativity, content reinforcement, relaxed environment, and variety in learning. The faculty evaluators indicated that the strategy promoted excitement, prior learning validation, group interaction, competition, and attention-seeking behavior.

Cessario (1987) carried out a quasi-experimental investigation on a convenience sample of 23 undergraduate and graduate students enrolled in courses dealing with conceptual models of nursing to investigate the effect of board gaming to motivate students to learn the content. The researcher-developed board game was field tested on 12 graduate students who had taken a course dealing with conceptual models of nursing to determine if there were any inconsistencies, unknowns and/or rule gaps when played. Ambiguous or inappropriate statements were reworded or deleted before the board game was used in the study. Instruments for data collection include a researcher-developed questionnaire and examination. The Likert-

type questionnaire was used to determine the experimental groups' post-intervention opinions on the experience. The 29-question multiple-choice examination, administered at both pre-test and post-test intervals, was used to evaluate conceptual models of nursing knowledge. An expert panel of four nursing theory instructors determined the construct validity of the examination. Results established that post-test scores of students in the experimental group were significantly higher than the control group ( $p < .05$ ). Additionally, percentages of responses on the questionnaire from the experimental group indicated all of these participants found the game to be motivating, fun, and a support to learning.

A quasi-experimental study conducted by Cowen and Tesh (2002) on a convenience sample of 85 pediatric nursing student undergraduates in one university, investigated the effects of gaming on student knowledge retention of pediatric cardiovascular dysfunction. Data collection was completed using two 15-question pre/post-examinations. Content validity was conducted using other pediatric nursing faculty and the instruments were pilot tested the academic year before the study. Test-retest reliability data on the final pre-test and post-test yielded  $r = .84$  and  $r = .80$  respectively. Internal consistency reliabilities were determined by Kuder Richardson scores (i.e., .73 for the post-test and .69 for the pre-test). Researchers determined that students who received gaming instruction answered 94% of post-test content questions compared to 85% in the comparison group receiving traditional instruction. Furthermore, after controlling for initial differences in pre-test scores, the post-test scores in the treatment group were significantly higher than in the comparison group ( $p = .0002$ ).

The staff development coordinators, Gruending et al. (1991), of one acute care hospital, appraised the use of gaming to educate staff nurses about the agencies policies and procedures. Data were collected from participant comments during a debriefing session and a questionnaire

administered after the intervention. The assessors reported that the majority of students agreed or strongly agreed that the experience of the gaming method for learning was fun, informative, and non-threatening.

Henry (1997) conducted a review of the literature to explore the use of gaming as a teaching strategy in nursing education. The appraiser found that more research is needed on its effectiveness for student learning but, what studies had been done illuminate that gaming adds innovation, diversity, immediate feedback, safety, and fun to instruction.

A stratified experimental crossover design was used by Ingram et al. (1998) to investigate a convenience sample of 131 four-year generic (Gn) and post-diploma (PD) two-year nursing students enrolled in Year III problem-based learning (PBL) courses at one school. The study explored the effects of gaming on students' abilities to generate hypotheses and learn issues. The sample was stratified by student type, Gn or PD, and then randomized to one of 14 PBL groups. An equal number of PBL groups from each student type were randomized to use either a game (GM) or conventional method (CM) during the first term (Term 1) for three PBL cases. The groups switched or crossed over to the opposite method in the second term (Term 2). Investigators collected data from student scores on posttests measuring: total responses, correct responses, accuracy, expertise, and breadth at the end of Terms I and II. Researchers found that during Term I GM users outperformed CM users on accuracy ( $p = .001$ ) and breadth ( $p = .023$ ); however, the findings in Term II demonstrated similar performance on all measures for both groups. Conclusions were that students' overall abilities to generate hypotheses or learn issues are similar whether they are instructed conventionally or with gaming.

A systematic review of the literature was undertaken by Kuhn (1995) to determine the current advantages and disadvantages of using the teaching technique of gaming. The

advantages of gaming were attentiveness from novelty, content mastery from review, improved critical thinking, reduced anxiety, increased involvement, decreased boredom, facilitated fun, and enhanced relaxation. Disadvantages of gaming were intensity of time use, a stress creator, an inconsistent evaluation tool, competitive, costly to develop, and reliant upon orientation and debriefing periods.

Montpas (2004) conducted a quasi-experimental pre/post-test longitudinal study on a convenience sample of 68 nursing students at one local community college to determine if student achievement and retention of geriatric nursing concepts differed for students who received gaming instruction versus traditional lecture. Data collection occurred using a researcher-developed examination for geriatric-nursing concepts, administered three times, once as a pre-test, and twice as a post-test (i.e., immediately after post-intervention and two weeks after post-intervention). Results showed that lecture was statistically more effective than gaming in the achievement scores between pre-test and post-test one ( $p = .000$ ) of geriatric concepts. However, retention of geriatric concepts was greater in the gaming group between pre-test and post-test two ( $p = .007$ ) than the lecture group. Conclusions from the research on the use of gaming as an instructional strategy for nursing are that it is an appropriate methodology as long as it is not used for immediate recall of information.

In 2007, Royse and Newton engaged in an exploratory review to determine if published evidence-based literature supported the use of gaming in nursing education as an innovative teaching strategy. The reviewers found that research on gaming instruction was scarce. However, located studies did report that gaming instruction was effective for improving learning outcomes specifically, knowledge retention, critical thinking, real-world problem solving, and motivation.

Schmitz et al. (1991) used gaming as an instructional strategy to teach two teams of four nurses on one general acute nursing unit of a large tertiary hospital a program on emergency decision-making skills. Evaluators found that gaming facilitated a safe environment for learning in collaborative groups, and accommodated learners with diverse preferences and needs.

In a study by Sisson and Becker (1988), nurse education coordinators at one urban acute care hospital used the instructional strategy of gaming in varied formats of board games to provide nursing education. Student and faculty evaluators of gaming indicated that the method was enjoyable, interesting, and a way to learn and review information.

Walljasper (1982) performed an exploratory search of the literature on the theoretical and practical aspects of gaming as an educational strategy. Conclusions were that games are like simulation exercises and involve competition. Additional conclusions included advantages and disadvantages of gaming to learning over traditional ways. Gaming advantages included actively involving learners in real-world problems or issues, requiring interaction, and motivating users. Disadvantages of games transpired if students are unable to abstract the ideas presented or follow directions, competition evoked negative emotions, and time investment exceeded the benefits of the gaming process.

To provide nursing education to newly hired nurses, Ward and O'Brien (2005) implemented gaming as an instructional strategy. The focus of the training was to facilitate staff development in the management of difficult clinical situations in a risk-free environment. Review of participant evaluations revealed that gaming promoted learning through action, experience, safety, fun, and interaction.

Overall analysis of gaming instruction and nursing content literature revealed student post-test scores were significantly improved or similar when gaming was used to deliver content when compared to students receiving traditional instruction. Moreover, student evaluators reported that gaming instruction stimulated group involvement, cooperation, competition, thinking, creativity, content reinforcement, a relaxing environment, variety in learning, motivation, and fun. Faculty evaluators indicated that gaming promoted excitement, prior learning validation, group interaction, competition, and attention-seeking behavior.

Further analysis revealed that more research is needed on gaming instruction and nursing content delivery exploring effectiveness to student learning especially when virtual clinical simulation software is used. In addition, more research with varied designs is needed, especially those with a quasi-experimental or experimental design. Of the studies located, researchers reported gaming instruction has the advantages of adding innovation, diversity, immediate feedback, safety, fun, attentiveness from novelty, content mastery from review, improved critical thinking, reduced anxiety, increased involvement, decreased boredom, learner involvement, real-world problem solving, interaction, motivation, and enhanced relaxation. Additionally, researchers reported the disadvantages of gaming as time intensive, stressful, an inconsistent evaluation tool, competitive, costly to develop, reliant upon orientation and debriefing periods, and less effective than traditional instruction when used as a methodology for immediate recall of information. Based on identified attributes of games from this analysis, games are distinguished as innovative structured simulated situations involving interaction of a player or players presented with conflict or problems to solve using rules, and when used as an instructional method enhances learning through content review, critical thinking, experience, enjoyment, and diversity.

### ***Simulation Instruction***

Simulation instruction refers to an instruction and evaluation method in which students practice “tasks and processes in ...[realistic]... circumstances using models or virtual reality, with feedback from observers, peers, actor-patients and video cameras to ...[develop]... skills” (Eder-Van Hook, 2004, p. 4). Assessment of the literature on simulation instruction and nursing content resulted in a finding of 16 studies. Overall, analysis of simulation instruction and nursing content literature revealed that the method promoted experience, technical skills and application of the nursing process. No published research was found reporting on virtual clinical simulation to deliver nursing content. Located studies are reported (Agazio et al., 2002; Alinier et al., 2006; Aronson, Rosa, Anfinson, & Light, 1997; Bearnson & Wiker, 2005; Bremner, Aduddell, Bennett, & VanGeest, 2006; Butler, Frotjold, & Hardy, 2007; Farnsworth, Egan, Johnson, & Westenskow, 2000; Feingold, Calaluce, & Kallen, 2004; Haskvitz & Koop, 2004; Kidd & Kendall, 2006; Larew et al., 2006; Morton, 1997; Nehring et al., 2001; Nehring & Lashley, 2004; Rodgers, 2007; Rowell & Spielvogel, 1996).

In 2002, Agazio et al. compared the effectiveness and user satisfaction of the virtual reality high fidelity Cath-Sim Intravenous Training system (Cath-Sim) to the traditional low fidelity IV arm while in Mission Oriented Protective Posture (MOPP) level 4 biochemical gear for Army healthcare personnel. Participants consisted of 50 Army medical personnel (i.e., RN's, physicians, medics, etc.) from Walter Reed Army Medical Hospital on active duty with previous IV insertion experience who were randomly assigned to the Cath-Sim IV group ( $n = 25$ ), or IV arm ( $n = 25$ ). No significant differences were found in the success rates, or time to success among groups. User evaluations identified IV simulation training as an effective to highly effective method due to multimedia cues, feedback, and scenario variety.



Alinier et al. (2006) conducted a pre/post-test quasi-experimental designed study to determine the effects of scenario-based training in a clinical intensive care laboratory using intermediate-fidelity human simulations on nursing students' clinical skills and competence. A convenience sample of 99 United Kingdom diploma adult nursing students was used. Data collection was performed using a mixed-mode Objective Structured Clinical Examination (OSCE). The OSCE assessment was composed of 15 short five-minute exercises or stations that students rotated through with each situation covering a particular clinical aspect using a practical skill or a theoretical pen and paper exercise. The experimental group was exposed to scenario-based simulation training within the stations and the control group was not. Researchers found no significant difference in student perceptions of confidence or stress between the control and experimental groups on a questionnaire about the use of technology in nursing practice. However, researchers did discover a significant difference demonstrated in the mean post-test scores ( $p < .001$ ) for competence of students who received simulation instruction.

To develop a Clinical Problem Solving Learning Laboratory (CPSL) with low-fidelity mannequins for 90 associate degree senior nursing students at one community technical college, Aronson et al., (1997), used the instructional strategy of simulation. Instructors developed nine faculty facilitated simulated patient care scenarios in lab rooms using medical devices along with fake documents displaying patient verbal and physiological cues. Student participant groups had to observe and react to the simulated patient scenarios using the nursing process to provide care. Faculty reported that the instructional strategy of simulation facilitated collaborative inquiry, critical thinking, decision-making, and problem solving for nursing

students in real world, but safe situations. Additionally, student evaluators of the strategy reported the learning experience as fun and non-threatening.

In 2005, Bearson and Wiker explored the benefits and limitations of using a high fidelity Human Patient Simulator Version 6 (HS6) on perceived student learning and self-efficacy in the management of post-operative pain in an exploratory, descriptive, mixed method survey and case study investigation. The sample consisted of two first year baccalaureate nursing student clinical groups who had completed five weeks of a six-week clinical rotation caring for post-operative patients at one university. Quantitative data collection was performed with a created questionnaire, using a Likert-type scale ranging from one (*strongly disagree*) to four (*strongly agree*). Qualitative data collection was conducted using three open-ended questions soliciting student opinions about what they had learned, what would improve their simulation sessions, and whether they would recommend engaging in the method again. Investigators found that students perceived their confidence and learning were increased from the experience, concluding simulation as a valuable asset to nurse training.

A mixed method study by Bremner et al. (2006) examined the value of high-fidelity human patient simulation (HS) from a convenience sample of 56 first year baccalaureate-nursing students. Comments and perceptions on learning were measured as overall experience, confidence, stress, anxiety, and curriculum value related to patient assessment. Data collection was performed using a two-part questionnaire. The first section of the instrument used questions with a Likert rating scale to solicit student perceptions about the overall experience of HS, the use of HS in the curriculum, and the influence of HS on confidence, stress, or anxiety in performing physical assessment skills. Information in the second section of the tool consisted of written student comments about the experience. Results of the quantitative data

demonstrated that overall, 95% of students rated the simulation experience from good to excellent. Additionally, 68% of students' valued simulation as an effective way to deliver nursing curriculum, with 61% reporting greater confidence and 42% less stress. Analysis of qualitative data revealed four emerging general themes. Results of the frequency distribution of the responses within each theme revealed that 26% reported on the realism of simulation, 76% on the use of simulation teaching/learning, 22% on the limitations of simulation, and 4% on the influence of simulation on their comfort/confidence.

In 2007, Butler et al. evaluated the use of simulation as a teaching strategy to instruct undergraduate nursing students on perioperative nursing using a Virtual Health Environment model created from an academic institution and clinical industry facilities collaborative venture. Students began the course experience in a nonthreatening environment in a state of the art simulation laboratory, progressed to a real operational suite for observation, and concluded with a three-week operational department clinical placement. The evaluators found that the realistic approach of the method resulted in an increased student interest to practice in the specialty and provided an increased pool of perioperative nursing applicants for hospital operating room vacancies.

In 2000, Farnsworth et al. examined student content retention of conscious sedation patient interventions using high-fidelity human patient simulation (HS) instruction in a quasi-experimental study. A convenience sample was used for the study, consisting of 20 nurses from one hospital working in areas where conscious sedation was administered. Data collection occurred at pre/post-intervention intervals using a 30-question multiple-choice examination, and at the post-intervention interval using an anonymous student satisfaction survey to rate the overall educational experience ranging from one (*equal to poor*) to four (*equal to excellent*).

Investigators evaluated that post-test scores improved significantly ( $p = .001$ ) concluding that simulations positively affect teaching/learning processes involving nursing interventions. Furthermore, the overall mean for student satisfaction with the educational experience was 3.75 indicating that participants rated the simulation education method as good to excellent.

Feingold et al. (2004) conducted a quantitative descriptive study to evaluate the use of high-fidelity human patient simulation from a convenience sample of 47 senior nursing students and four faculty members in one Advanced Acute Care of the Adult undergraduate baccalaureate-nursing course. Data were collected using student and faculty surveys. The student survey had characteristic and perception questions. Four characteristic questions were used to solicit information on gender, age, grade point average, and ethnicity. Student perception data was obtained by a 20-item self-rated questionnaire using a 4-point Likert format about the value of the overall learning experience, the ability to transfer skills from simulation to real clinical situations, and the realism of the experience when simulation was used. The faculty survey had perception questions related to the value, realism, and transferability of skills from HS, and consisted of 17 items using the same Likert format. Researchers established that there were high scores for student agreement that simulation was realistic (86.1%), a valuable learning experience (69.3%), and a good test of decision-making (87.7%) and clinical skills (83%). In addition, investigators found that there were high scores for faculty agreement that simulation was realistic (100%) and a good method to prepare students to function in real clinical situations (100%).

In a descriptive qualitative exploration, Haskvitz and Koop (2004) proposed a model of remediation using high-fidelity human simulation instruction for clinical skill remediation for students having learning difficulties. The authors recommended a four-step process model

consisting of assessment, planning, implementation, and evaluation that nurse educators could use to guide teaching with patient simulators.

In 2006, Kidd and Kendall performed an assessment of the literature to examine the current issues regarding the use of simulation for advanced cardiac life support (ACLS) training of nurses and other healthcare professionals. Reviewers concluded that ACLS training using collaborative teams in practical real-world experiences using simulation scenarios should improve ACLS outcomes because it enhanced learning by stimulating critical thinking, technical skill competence, communication, assessment, and reflection.

An instructional protocol developed and implemented by Larew et al. (2006) was used to educate 190 junior and senior baccalaureate adult health students in a clinical laboratory using high-fidelity human patient simulation with escalating vague to specific verbal and physiological cue progression. The goal of the initiative was to facilitate practice performance of novices while challenging higher functioning students on patient management and collaborative practice skills. Evaluations revealed that simulations provided a vast amount of information on student weaknesses and strengths and required multiple assessment techniques such as written examinations, digital recording, and performance tools. Additional evaluation findings revealed that simulation in clinical laboratories was expensive to start up and labor intensive to use, requiring time for instructional protocol development, constructed environment orientation, patient information collection, student-directed scenario pacing, debriefing sessions, and technical staff support. Designers concluded that simulation instruction in clinical laboratories offered a way to provide safe, structured, and consistent learning experiences for all students.

In 1997, Morton reviewed the literature on simulation as a teaching method to determine the advantages and disadvantages of using this approach to teach critical care nursing. Simulation offered the opportunities for learning through safe low anxiety controlled environments, student engagement, immediate feedback, and reinforcement. Depicted disadvantages included costs for obtaining and maintaining equipment, and a limited ability to mimic the reality of a high-stressed, fast-paced, emotionally charged environment in a critical care unit. Moreover, the reviewer identified that the learning prospects of a critical care simulation laboratory were many. For instance, the lab offered faculty ways for teaching that promoted development of learning in the cognitive domain that encompassed “knowledge, comprehension, application, analysis, synthesis, and evaluation of information” (p. 67). In addition, instructors can facilitate the affective domain of learning, depicted as an emotional element, consisting of feelings, values, and ideas, with simulation through nursing role exercises in real-world experiences. Lastly, educators can promote development of the psychomotor domain of learning that involves technical skills, tasks, and procedures because simulation provides a safe environment allowing the opportunity for experience and knowing that comes from doing or practice.

Nehring et al. (2001) introduced the instructional framework of critical incident nursing management (CINM) for teaching that used high-fidelity computerized mannequin human patient simulation (HS) in clinical laboratories. CINM allowed students to assess the patient incident through interaction by observing physiological and verbal cues, planning care based on current and changing information, intervening to correct the situation and evaluating to take additional or altered steps. Thus, the authors contended that the outcome of simulation CINM instruction was appropriate for nursing students because it facilitated “satisfactory performance

of nursing care using appropriate knowledge, technical skills and critical thinking within the nursing process model” (p. 195).

Nehring and Lashley (2004) conducted a descriptive study of an international sample of 34 schools of nursing (33 in the US, one in Japan) and six simulation centers (one each in Australia, England, New Zealand and US, two in Germany) to explore the use of high-fidelity human patient simulators (HS) in nursing education. Data were collected using a researcher-designed 37-item closed and open-ended survey. Content validity was conducted through a literature comparison and expert panel review. Investigators found that HS was used more in advanced medical-surgical courses in community college programs ( $M = 11.18$  hours,  $SD = 10.21$ ) compared to the basic skills courses in university programs ( $M = 3.77$  hours,  $SD = 10.96$ ). Furthermore, 93.8% of all schools indicated that 25% or less of faculty used HS. Additionally, researchers found that undergraduate university programs used HS most often for competency evaluation and in the areas of knowledge synthesis (76.9%), technical skills (61.5%), and critical event management (53.8%).

Rodgers (2007) conducted a quasi-experimental study investigating the effect of simulation instruction on educational outcomes in advanced cardiovascular life support (ACLS) training using a convenience sample of 34 senior nursing students, 16 in the treatment group (high-fidelity manikin instruction) and 18 in the comparison group (low-fidelity manikin instruction), from three Central and Southern West Virginia higher education institutions. Instruments used for single measure data collection included: the demographic survey, modified ACLS Mega Code Performance Score Sheet, Affective Learning Scale, and Student Motivation Scale. Instruments used for pre/post-test data collection included ACLS written examinations and a Participant Self-Assessment. Findings indicated that neither the high-

fidelity manikin nor low-fidelity manikin simulation group significantly outperformed the other on the post-tests. However, the high-fidelity manikin-based instruction group did significantly improve their cognitive knowledge between pre/post-test scores compared to the low-fidelity manikin instruction group ( $p = .002$ ).

Rowell and Spielvogle (1996) instructed healthcare personnel in one acute care hospital using simulation techniques. The purpose of the training was to increase awareness of staff about infection control practices. The simulation consisted of a created isolation room developed with 37 infractions or violations of good infection control practices in an actual patient room. Participants received a mock patient scenario and instructions directing them to search and identify as many infractions as they could find before entering the simulation. Evaluations revealed that students found the method to be fun and informative.

Overall analysis of the literature on simulation instruction and nursing content revealed current published information related to use of the strategy in lab settings predominantly using low or high fidelity manikins or props. No published literature was found investigating student learning of nursing content with virtual clinical simulation instruction using software. Most of the research on simulation instruction used a descriptive and quasi-experimental design. Student evaluators of simulation instruction reported that it promoted multimedia cue use, feedback, scenario variety, fun, safety, confidence, increased learning, experience, less stress, nursing curriculum delivery, and nurse training.

Faculty evaluators of simulation instruction to deliver nursing content reported advantages including facilitating collaborative inquiry, critical thinking, decision-making, safety, problem solving, structured environments, consistent learning, student-directed scenario pacing, real world situations, student interest to practice in the specialty presented in a



simulation, required multiple assessment techniques, and provided student performance data. Faculty identified advantages of simulation instruction for critical-care nurse training included student engagement, immediate feedback, reinforcement, safety, practice, knowledge comprehension, application, analysis, synthesis, evaluation, feeling and value use, ideas, role playing, and real-world experience. Instructor reported disadvantages for simulation instruction for critical care training of nurses included cost for obtaining and maintaining equipment and limited ability to mimic the reality of a high-stressed fast-paced emotionally charged critical care environment.

For students who received simulation instruction, researchers found that students had improved competence, student satisfaction, practical experience, learning experience, decision-making skills, clinical skills, and realism. Additionally, researchers found simulation instruction was used differently in community colleges typically for advanced medical-surgical courses compared to basic skills courses in university programs. Few faculty used simulation in colleges or universities, and undergraduate university programs used simulation most often for competency evaluation to assess knowledge synthesis, technical skills, and critical event management. In addition, one researcher reported students trained with high fidelity manikins significantly improved their cognitive knowledge between pre/post-test scores compared to those instructed with low-fidelity manikins.

Further analysis of research literature revealed a four-step process model consisting of assessment, planning, implementation, and evaluation was recommended to guide simulation instruction. Moreover, researchers found that simulation instruction using collaborative practical real-world experience in teams enhanced learning by stimulating critical thinking, technical skill competence, communication, assessment, and reflection. In addition, simulation

instruction was effective for critical incident training because it promoted realism, teaching/learning, learner comfort and confidence from experience, interaction, observation, and application of knowledge, technical skills and critical thinking using the nursing process model of assessment, diagnosis, planning, intervention, and evaluation.

Based on the identified elements of simulation to deliver nursing content from this review, simulation is identified as a means and method. Simulation instruction is a way to deliver nursing curriculum in an enjoyable safe student-directed structured realistic healthcare environment using interactive multimedia scenarios to promote learning from experience in nursing practice and process application while problem solving independently and collaboratively using feedback to gain competence in knowledge, skills, and behaviors needed in the nursing role.

### ***Gaming Simulation Instruction***

Review of the literature on gaming simulation instruction and nursing content resulted in a finding of one descriptive study. Overall analysis of gaming simulation instruction literature is that more research is needed using experimental, quasi-experimental and descriptive designs to build the body of evidence. Findings from the study are reported (Sauvé et al., 2007).

A systematic review of the literature by Sauvé et al. (2007) on 98 articles and research reports that provided a definition of or discussed critical attributes of games and simulations was conducted to identify and describe the essential attributes of educational games and simulations. The authors determined that games have the attributes of a player or players, conflict, rules, predetermined goals, artificial environment (reality or fiction referenced), and if

educational, a socioconstructivist pedagogy. Moreover, Sauv   et al. (2007) used the gaming literature to define a game as:

A fictional, fantasy or artificial situation in which players, put in conflict with one another or against other forces, are governed by rules that structure their actions in order to meet learning objectives and a goal predetermined by the game (for example, winning, being victorious or overcoming an obstacle). (p. 251)

In addition, Sauv   et al. (2007) identified that simulation elements include a reality system, dynamics, simplicity, precision and learning. Using the identified attributes, Sauv   et al. (2007) defined a simulation as “a simplified, dynamic, and accurate model of reality that is a system used in a learning context” (p. 253).

Analysis of the literature on gaming simulation instruction and nursing content resulted in the finding that gaming simulation instruction has the component of realism or real-world experience. Furthermore, the terms game and simulation have been defined and used differently with games distinguished as simulated situations where a player or players are put in a position of conflict, governed by rules, structured, and when used for teaching are integrated into educational content to enhance learning in the cognitive, affective, and/or psychomotor domains. Contrarily, simulations are pronounced as a basic, dynamic, accurate, portrayal of a reality system, unless, the method is merged into a simulation game. When gaming simulation combines like in a virtual clinical simulation using educational gaming software, then, the demonstrated attributes of each merge into a definition. Based on the attributes identified in this review, gaming simulation is a two or three dimensional dynamic virtual reality system requiring a player or players to interact with visual, auditory, kinesthetic or psychomotor digital

media to discover conflict or problems and seek resolution using rules and processes toward specific or directed learning objectives.

Analysis of the gaming simulation instruction and nursing content literature revealed that more theory generating and testing research is needed in this area since only one descriptive study was found. No published studies were located reporting on the use of virtual clinical simulation instruction applied with digital media educational gaming software. This reveals a gap in the literature especially on its effects to teaching/learning, prompting a need for research to add to the body of knowledge.

### **Learning Theory**

Learning is “the process through which experience causes permanent change in knowledge or behaviors” (Woolfolk, 2004, p. 603). Moreover, a theory refers to an event clarification made-up of integrated principle statements that attempt to make a prediction about something (Woolfolk). Thus, reasoned definitions of learning theory are presented as a forecasted explanation about learning based on a set of integrated principles and categorized by the variance in the main belief sets to predict learning. Analysis of the literature on gaming simulation instruction and learning theory revealed various theories to predict learning with this strategy (De Miranda, 2004; Henry, 1997; Hmelo-Silver, 2004; Leigh & Spindler, 2004; Lewis et al., 1989; Paas et al., 2003; Peters, 2000; Spigner-Littles & Anderson, 1999; Vogel & Klassen, 2001; Ward & O’Brien, 2005).

### ***Adult Learning Theory***

In 1997, Henry reviewed the literature to examine the relationship between adult learning theory and gaming. Adult learning theorists contend that adults are self-motivated, self-directed individuals who prefer learning that involves active participation, practical

experience, variety, feedback, and real-world problem solving. Gaming/simulation is an educational strategy that promotes interaction, decision-making, practice, feedback, and diversity. Conclusions are that gaming is an appropriate method of instruction to use for adult learners.

In 1989, Lewis et al. explored the theoretical aspects of gaming as an instructional strategy for adult learners. Gaming instruction was found to incorporate interaction, stimulate cognitive process, and facilitate a non-threatening learning environment. Adult learning theory suggests adults prefer learning in enjoyable, stimulating, and interactive environments. The authors concluded that gaming is an appropriate method of instruction for adults.

An appraisal of the literature by Spigner-Littles and Anderson (1999) determined effective learning theories, methodologies, and techniques with adult learners. Appraisers found two well-established theories for adult learners, Cognitive Learning Theory that characterizes experience as a contributing aspect in learning described as permanent behavior transformation, and Constructivism, which assumes that understanding acquisition, constructs from experience. Identified instructional/teaching methods and techniques consistent with Cognitive and Constructivist Learning Theories were simulated real life scenarios or problems, probing, questioning, goal setting, self-evaluation, project supervision, critical thinking, collaboration, group participation, facilitated discussion, cooperative learning, active participation, student-centered instruction, and social interaction.

In 2005, Ward and O'Brien analyzed the literature to determine if the instructional method of gaming is suitable for adult learners. Adult learners were established as independent and active students who seek learning for a skill or knowledge need, retain knowledge by integrating new information with current understanding, and favor learning environments that

provide practice and involvement. Gaming was considered an instructional method that supports learning because it promotes student enjoyment, critical thinking, confidence, creative behavior, divergent thinking, knowledge retention, collaboration, calmness, interaction, communication, experience, practice, security, ideas, and opinion. Conclusions were that gaming instruction is suitable for adult students because it is an informative interactive strategy suitable for the needs of adult learners for new information or skills, and it combines new and current knowledge in realistic practical settings.

### ***Chaos Theory***

Leigh and Spindler (2004) searched the literature to establish if a chaos theoretical framework could be of benefit in understanding and managing the structure and management of open simulations. Chaos theory refers to dynamic systems that contain order and logic that change continuously never repeating themselves. Moreover, chaos theory assumes that active arrangements and methods combine order and reason in chaos to culminate in a chaordic event. Open simulations were found to refer to activities designed to guide students to acquired “insight into the complex relationships and interconnected structures within a particular context” (p. 54). Reviewers established that open simulations mean virtual experiences representing wholes created by improviser educators to sensitize or prepare learners for action in patterned chaotic and unpredictable real life settings. The role of educators in open simulations is one of an improviser using readiness, vigilance and reassurance in the unpredictable chaordic environment rather than commands, controls, and directions to promote student participants to engage, interact and reflect on the whole scenario to learn and understand from the event. Conclusions were that open simulations were chaotic events within

an ordered scenario making them chaotic, a view that emerges from the assumptions of chaos theory.

### ***Cognitive Theory***

To review the relationship between cognitive science theoretical viewpoints and technology education, De Miranda (2004) examined the literature. Technology education is identified as an emerging discipline that evolved from practical collaborative projects and problem-based teaching/learning. Discussion determined that cognitive science proposes that students not teachers are responsible for the cognitive tools for learning. In other words, students must process information to learn through the self-regulation and monitoring of the cognitive functions of memory, thinking, reflection, and application. Additionally, cognitive science recommends that teachers create instructional strategies to promote student action and collaborative participation that integrates the cognitive and metacognitive strategies for employing, managing, evaluating, restructuring, and discovering knowledge. Identified shared learning and instruction elements between technology education and cognitive science included engagement, reflection, and interaction. Both cognitive based science and technology education promote learning-in-doing that comes from the authentic practical experience of solving problems with virtual or simulated scenarios, situations, or projects. Conclusions drawn were that technology based instructional practices align with the theoretical perspectives of cognitive science theory.

Analysis of the literature was undertaken by Paas et al. (2003) to ascertain cognitive load measurement techniques used within a cognitive load theory framework. Cognitive load theory (CLT) assumes that individuals have limited cognitive processing capacity or short-term working memory to apply or transfer acquired information to new situations compared to an

unlimited long-term memory that interacts or processes visual/auditory information. Based on this premise, cognitive theorists argue that instruction should be designed to be effective and efficient to promote schema construction and automation. Discussion acknowledged that the cognitive load rating scale, in a non-modified format, reliably measures mental effort.

However, variances on instructional efficiency calculations exist. One study pooled mental effort invested with test performance to attain mental efficiency of test performance that related to the transfer of acquired knowledge. Subsequent studies joined mental effort spent during training with test performance to reflect mental efficiency of training or learning efficiency. Another study combined learning effort, test effort, and test performance to depict a more sensitive instructional efficiency. Further analysis revealed that a gap in research exists on the influence of time on task in mental efficiency, as well as the effect of combining mental effort with performance measures in intelligent interactive learning systems like virtual reality simulations.

### ***Constructivism***

Hmelo-Silver (2004) evaluated the literature to determine if the constructivism premise that learners build knowledge from reflecting on their experience was congruent with the use of problem-based learning (PBL) simulation in education. Virtual reality based PBL refers to an instructional approach that promotes student knowledge construction through reflection on experience or practice within a complex scenario or real-life problem simulation. The evaluator determined that the evidence-based research on the use of this strategy is scarce and restricted to healthcare educators. Conclusions established that PBL simulations are practical learning experiences that prompt knowledge construction or understanding through reflection, problem-



solving abilities, and self-directed learning skills in adult learner healthcare providers and are congruent with constructivism.

In 2000, Peters reviewed the literature to determine if constructivist epistemology had a place in undergraduate nursing education. Discussion characterized nursing students as adults with life experiences who enter nursing programs with a vast amount of formal and informal knowledge. The reviewer identified that traditional pedagogy in nursing education included lecturing by teacher experts without regard to acquired knowledge in students, promoting regurgitation of new information in tests and assignments and de-emphasis in understanding. Furthermore, the investigator offered constructivist epistemology as an option to adult learner nursing students over traditional pedagogy because it promoted the focus of knowledge from the teacher to the learner, understanding comes from experience of the world, self-directed learning is enhanced, sociocultural interaction influences learning, and previous learning is a foundation on which new knowledge can be constructed. Reported conclusions were that a constructivist framework is appropriate for educating undergraduates because real world simulations or experiences that involve nursing practice enhance transferable understanding in nursing students because the model promotes reflective practice, evaluation, critique, self-learning, and metacognitive awareness.

Vogel and Klassen (2000) examined the literature to determine the theoretical aspects of technology-supported learning. The assessors established that multimedia instruction refers to integrative computer-based interactive multimedia instruction that may include CD-ROMs and the World Wide Web as a part of the delivery of content that promotes student-directed or self-accessed learning constructed through interaction. The role of teachers in technology-supported learning is as instructional developers and collaborators who promote competency development

and talents in student participators through multimedia enabled individualized events, cooperative activities, and real time assessment. Furthermore, learning with multimedia technology was characterized as flexible, accommodating a plurality of learning styles and learners who can experience multi-sensory realistic simulations to develop skills and abilities in decision-making, critical thinking, communication, team-building, self-assessment, knowledge comprehension and retention. Conclusions drawn were that multimedia instruction in education provides the opportunity to promote learning that is student-centered, flexible, diverse, collaborative, social, interactive, and realistic, compatible with the notions of constructivism.

Overall analysis of the literature on learning theory and gaming simulation instruction revealed that adult learning theory, chaos theory, cognitive theory, and constructivism all predict learning from the method because it is found to be an interactive, student centered, multimedia enhanced, problem based, realistic experience that facilitates knowing from doing. Thus, published theoretical works on learning theory provide sufficient information for theory testing research exploring gaming simulation instruction.

### **Student Characteristics**

Student characteristics refer to the distinct qualities that today's students have from their development throughout life exposed to digital technology that differs from previous generations (Howell, 2004; Prensky, 2001a, 2001b; Tapscott, 1998). Analysis of the literature on student characteristics and digital technology revealed three studies reporting on today's students as digital natives developed with digital technology experience making them learners with unique characteristics. Studies found from this review reporting on digital technology and student characteristics are reported (Howell, 2004; Prensky, 2001b; Tapscott, 1998).

Howell (2004) explored the literature to determine issues surrounding the teaching and testing practices used with technologically well-informed students who “communicate, learn, and almost live on keyboards... [and]...the computer” (p. 75). The evaluator identified that the characteristics of knowledgeable digital technology students included computer access, impatience with old-fashioned teaching or testing practices, a preference for keyboarding to handwriting for communication, and attainment of refined motor skills from interaction with digital devices and gaming experience. In addition, the assessor established that evidence exists that instructional practices are changed or changing to incorporate rich multimedia and multidimensional context into the learning environment but testing practices have essentially stayed in a paper-pencil format, threatening the reliability and validity of these tests when used to evaluate technologically proficient learners. Conclusions are that educational reform to create and use multimedia tests for assessment of student learning in digital native students is necessary to match the multimedia instruction they are receiving.

To determine the evidence on experience and cognitive skill development in digital natives, Prensky (2001b) analyzed the literature. Neurobiology research established that various stimulations changed brain configurations and cognitive processing throughout life resulting in continuous brain restructuring known as neuroplasticity. Neuroplasticity results when a recipient attends to an input or task sharply focused in frequent sessions over time. Social psychology research validated that people who are cared for in dissimilar cultures or circumstances have different thinking demonstrating that cognitive processes have malleability to experience. Conclusions were that no explicit evidence exists on digital native experience and cognitive skill development. However, evidence that different experiences resulted in changed brain arrangements could be reasoned to digital natives because they have received

focused frequent interactive sensory information from digital multimedia over time through video gaming and computer Web-surfing. Thus, because of their life experience the author concluded that digital native students think differently.

Tapscott (1998) conducted a qualitative study to explore the Net-Generation (N-Geners), described as “the generation of children who, in 1999, will be between the ages of two and twenty-two, not just those who are active on the Internet... [but those that]...have some degree of fluency with the digital media” (p. 3). Data was collected from online discussions, forums, and surveys, investigating the opinions of 300 Internet users aged from four to 20 over a one year period and from interviews conducted over an eight month period with dozens of adult experts from the disciplines of childhood developmental psychology, economics, marketing, sociology, psychology, pedagogy, technology, parenting, and business strategy. Analysis revealed N-Geners as a unique group because of their life experience using digital media, including the Internet, to explore, discover, read, speak, write, create, and communicate more than previous generations. N-Gener attributes were described as inquisitive, tolerant, self-confident, independent, argumentative, highly intelligent, connected, experiential, social, and service oriented. In addition, because of their interactions with digital media to acquire information, N-Gen learners expect immediacy, structure, engagement, teamwork, and visual and kinesthetic media with instruction. Conclusions were that these unique learners require educational change and reform from traditional methods of lecture to digital media enriched approaches.

Overall analysis of the literature on digital technology and student characteristics revealed digital native students think and learn differently than previous generations because of their unique life experience of developing with digital media. Because digital native students

learn differently due to development from digital media exposure, educational reform away from traditional methods of lecture to multimedia methods is needed. Virtual clinical simulation instruction is a multimedia enriched method of teaching that employs the application of educational gaming software to deliver nursing content and is appropriate for today's digital native nursing students.

### **Achievement**

Achievement in nursing refers to student performance on standardized objective nursing knowledge/content assessments (ATI, 2008; NCSBN, 2004; Newton, Smith, Moore & Magnam, 2007; Rushton & Eggett, 2003; Seldomridge & DiBartolo, 2004). Student achievement on standardized examinations and evaluations has high-stakes. For instance, in the US all nurse graduates must achieve success on the National Council Licensure Examination for Registered Nurses (NCLEX-RN<sup>®</sup>) to gain licensure for practice (NCSBN, 2004). Furthermore, the National League for Nursing Accrediting Commission, Inc., (NLNAC) and State Boards of Nurse Examiners use the NCLEX-RN<sup>®</sup> passage rates as criteria for nursing program accreditation (NCSBN, 2004; NLNAC, 2008). Because students and programs are penalized for poor NCLEX-RN<sup>®</sup> performance, schools of nursing are using standardized examinations developed by independent companies such as Assessment Technologies Institute (ATI), LLC that use the NCLEX-RN<sup>®</sup> Test Plan to create objective measures to determine readiness of graduates for achievement on NCLEX-RN<sup>®</sup> material (ATI, 2008; Jacobs & Koehn, 2006). Analysis of the literature for methods used to determine student readiness for NCLEX-RN<sup>®</sup> achievement are presented (Davenport, 2007; Jacobs & Koehn, 2006; Mosser et al., 2006; Newman & Williams, 2003; Seldomridge & DiBartolo, 2004).

Davenport (2007) reviewed the literature to identify evidence to support specific interventions that are most successful in preparing nursing students for achievement on the NCLEX-RN<sup>®</sup>. The reviewer found that limited evidence exists on the effectiveness of strategies with the only significant correlation reported to be two content exams. The recommendation to programs was to use content-area exams to assess student readiness for NCLEX-RN<sup>®</sup> achievement. In addition, the investigator administered an Internet survey to 26 Indiana associate of science nursing programs to determine successful curriculum planning and delivery strategies used to promote student achievement on NCLEX-RN<sup>®</sup>. Nine schools responded. The ATI comprehensive remediation and testing package was reported as the most commonly used approach to improve test results. Conclusions were that initiation of a comprehensive assessment and remediation package is appropriate because it helps students refine test-taking skills, remediate and increase content knowledge, understand the testing process, advance critical thinking skills, and increase confidence.

An analysis of the literature by Jacobs and Koehn (2006) was undertaken to determine if student achievement on NCLEX-RN<sup>®</sup> by graduates of one large public U.S. Midwestern university school of nursing could be affected by implementing known success factors. Aspects associated with NCLEX-RN<sup>®</sup> success identified from the review included: implementing admission criteria, identifying at risk students, requiring above average exam and quiz scores, using interactive teaching, incorporating analytical and synthesis level exam questions, providing NCLEX-RN<sup>®</sup> material review and remediation, and facilitating student familiarity with computerized testing. Assessors implemented the comprehensive standardized computerized testing and remediation program developed by ATI consisting of pre-admission screening assessments, RN content mastery series review modules, non-proctored and

proctored RN content mastery series examinations, and a RN Comprehensive Predictor Examination™. No psychometric information was reported on the reliability or validity of the ATI examinations. Evaluators reported that the NCLEX-RN® passage rates increased from 86% for three previous years to 92% for the first class graduating after the program instituted the ATI comprehensive testing and remediation program.

In 2006, Mosser et al. evaluated the effect of progression testing using the ATI computerized remediation and evaluation program at two Northeastern baccalaureate-nursing programs to student achievement on the NCLEX-RN®. Researchers found that the program attained at least an 80% pass rate for the subsequent three years with the highest pass rate of 96% attained in the third year of the ATI programs implementation. Investigators concluded that progression testing was a key to promoting success on the professional nursing licensure examination.

Newman and Williams (2003) appraised the use of a comprehensive computerized systematic testing and review program developed by ATI in one nursing education program, implemented to promote nursing school and post-graduation NCLEX-RN® success for all students. Evaluators reported that the ATI testing program assessed students' basic competencies on admission and verified knowledge achievement at the completion of courses with standardized content mastery exams. No psychometric data were reported on the reliability or validity of the ATI testing instruments. Furthermore, the reviewers found that ATI provided individually reported evaluations for students, providing specific information on areas of content deficiency that could be used by faculty to guide remediation.

A retrospective descriptive study by Seldomridge and DiBartolo (2004) on a convenience sample of 186 student nurses who graduated from 1998 through 2002 from one

rural public baccalaureate-nursing program was conducted to determine the variables that predicted student achievement on the NCLEX-RN<sup>®</sup>. Data were collected using the National League for Nursing Comprehensive Achievement Test for Baccalaureate Students (NLN-CATBS) and student files. Researchers found that test average post medical-surgical coursework and percentile performance on the NLN-CATBS predicted 94.7% of NCLEX-RN<sup>®</sup> passes and 33.3% of failures. Additional findings were that the NLN-CATBS percentile score and the pathophysiology grade predicted 93.3% of NCLEX-RN<sup>®</sup> passes and 50% of failures. Recommendations to programs who want to use evidence-based practices to facilitate student success on NCLEX-RN<sup>®</sup> included initiation of student admission and progression criteria. Suggested student admission and progression criteria includes a GPA of 2.5 or greater in science coursework, a minimum grade of C in pathophysiology and medical-surgical nursing coursework, and a computerized comprehensive nursing knowledge evaluation and remediation program for all students enrolled in nursing courses.

Overall analysis of the literature on methods used to determine student readiness for NCLEX-RN<sup>®</sup> achievement revealed five descriptive studies and a finding that the only significant correlation to predict student readiness for NCLEX-RN<sup>®</sup> achievement came from two content exams. No experimental or quasi-experimental studies were found exploring student achievement and readiness methods. Furthermore, no psychometric data were reported on the standardized exams evaluated in the located studies, exposing a gap in the literature. Therefore, more research investigating methods used to determine student readiness for NCLEX-RN<sup>®</sup> is needed using varied research designs, and reporting on the reliability and validity information of the instruments used in the studies.



Analysis of the located studies reporting on methods used to assess student readiness for NCLEX-RN<sup>®</sup> achievement revealed that standardized content specific testing is the evidenced based practice used most by nursing education programs. Furthermore, this review found that the ATI comprehensive remediation and standardized testing package was the most commonly reported tool. In addition, the determined attributes of nursing education programs that prepare graduates for NCLEX-RN<sup>®</sup> success were implementing student admission and progression criteria of a 2.5 or greater GPA in science courses, a minimum grade requirement of a C in pathophysiology and medical-surgical nursing courses, and a computerized comprehensive nursing knowledge evaluation and remediation program for students in all nursing courses. Other elements from this analysis determined to be associated with nursing education program graduate success on NCLEX-RN<sup>®</sup> were identifying at risk students, requiring above average exam and quiz scores, using interactive teaching, incorporating analytical and synthesis level exam questions, facilitating student familiarity with computerized testing, and providing NCLEX-RN<sup>®</sup> material review and remediation.

### **Competence**

Competence refers to the information, skills, and actions that a professional needs to perform a particular role (Competence, 2008; Competence, n. d.; U.S. Department of Education, 2002). Thus, competence is multifaceted requiring various strategies for development and evaluation (Piercey, 1995; Redfern et al., 2002). Clients of a continuously changing US healthcare delivery system have mandated that schools of nursing provide students with current and practical learning to achieve competency in the professional nursing role (Pew Health Professions Commission, 1998). Because nursing schools have a responsibility to develop competent students for entry into the profession and competence is

complicated, programs use a variety of means for assessment. Analysis of the literature reveals five varied studies describing or exploring competency assessment in nursing education (Piercey, 1995; Redfern et al., 2002; Sifford & McDaniel, 2007; Slezak & Saria, 2006; Yaeger et al., 2004).

In 1995, Piercey evaluated current literature on ways nursing programs assess clinical competence. The appraiser established that varied definitions of competency exist ranging from a narrow focus of psychomotor skills in a vocation up to holistic interpretations incorporating values, ethics, and reflective practice based on standards of a profession. Overall findings of the evaluation were that the profession of nursing defines competency based on complex standards and that nursing programs use mixed approaches of observation (i.e., critical incident performance), written communication (i.e., examination, case studies, and journaling), and self-evaluation for competency assessment.

Redfern et al. (2002) assessed the literature to determine the quality of the methods used in assessing competence in nursing. The identified methods were questionnaire rating scales, observation ratings, criterion-referenced rating scales, simulations, objective structured clinical examinations, practice assessments and reflections, self-assessments, and multi-method approaches. Conclusions were that the competency assessment methods used in nursing have been inadequately evaluated and are lacking psychometric information prompting a need for research to develop and determine objective, reliable, and valid means that are grounded in theoretical frameworks. Furthermore, recommendation was made to nurse educators to take a triangulation or multi-method approach toward competency assessment to enhance validity of the evaluation and to capture the complex repertoire of cognitive, affective, and psychomotor skills required of students.

In 2007, Sifford and McDaniel investigated 47 senior baccalaureate nursing students' performance on a commercially available comprehensive NCLEX-RN<sup>®</sup> predictor exit exam before and after students received a 15-week competency remediation course that included test-taking strategies, anxiety reduction techniques, and weekly practice experiences. Results indicated that student performance significantly improved following the intervention ( $p < .001$ ). Conclusions were that competency remediation instruction inclusive of practical experiences improved student performance on a comprehensive exit exam in one nursing program.

Slezak and Saria (2006) designed and implemented a structured competency evaluation and update session to 118 oncology nurses at one tertiary university-affiliated medical center located in the Southwest region of the US. Researchers used a simulated clinical practicum, a self-directed learning module, lecture-discussions, demonstration/coaching, case studies, and video presentations over a 4-hour period to evaluate and remediate competence in oncology staff nurses. Discussion determined that inconsistency was prevalent in the practice of competency development among healthcare institutions and departments. Evaluation of the project established that a structured competency validation process inclusive of a simulated clinical practice scenario at one institution was effective in standardizing oncology-nursing practice.

An analysis of the literature by Yaeger et al. (2004) was undertaken to reveal if nurse educators could use simulation instruction to develop professional competence in nursing students. The appraiser determined that Bloom's Taxonomy of six hierarchical levels that evolve from lower to higher levels of cognitive complexity provides a foundation to determine student nurse competency needs. Using the taxonomy, the authors argued that student nurses need an educational experience that includes development of learning from lower levels of

knowledge, comprehension, and application accomplished through traditional instructional models of lecture, textbooks, and videos, to higher level learning experiences. Furthermore, the reviewers maintained that the higher levels of learning development are essential to professional nurse development because they facilitate student abilities to analyze, synthesize, and evaluate content knowledge obtained at lower levels and must be included in nursing education programs. Conclusions were that simulation instruction provided the means for nurse educators to develop professional nurse competencies in students by providing increased realistic practical experiences where students could improve performance and enhance understanding of content in a safe environment.

Overall analysis of the literature on competency assessment in nursing education revealed four descriptive and one quasi-experimental study. No experimental studies were found. Conclusions are that more research is needed in nursing exploring competency assessment methods especially studies reporting psychometric information on objective, reliable, and valid tools. Further analysis revealed the recommendation to nurse educators to use a multi-method approach for competency assessment to enhance validity using observation (i.e., simulations), written communication (i.e., examination, case studies, and journaling), and self-evaluations.

### **Opinion**

An opinion is defined as a view, judgment, or appraisal formed in the mind of a person about a particular matter (Opinion, 2008). For example, a student forms an opinion about the various instructional strategies encountered as a learner. Opinions have been used in other studies for data collection (Blatchley, Herzog, & Russell, 1978; Nehring & Lashley, 2004). Therefore, an educator who wants to elicit information about an instructional method that was

used to deliver medical-surgical content determined from the NCLEX-RN® Test Plan and tested on NCLEX-RN® can use a student opinion question on how that strategy affected learning to gain insight and depth on the intervention.

When a person forms a belief or judgment about a specific matter, they are forming an opinion based on their individual assessment (Opinion, 2008). Student opinion or evaluation has been used as a source of data collection using open-ended surveys and questionnaires to solicit in-depth insight into students' values, satisfaction, beliefs, feelings, and perceptions. Analysis of the literature on opinions and nursing content revealed two studies conducted using this technique (Blatchley et al., 1978; Nehring & Lashley, 2004).

Blatchley et al., (1978) conducted a mixed method longitudinal study on the effects of self-study on achievement in medical-surgical nursing courses with a convenience sample of 359 medical-surgical nursing students enrolled in six consecutive classes at one higher education institution. Measurement of student opinions using a questionnaire with an open-ended comment section and knowledge using pre-test and post-test written examinations were used for data collection. Researchers reported that self-study methods were as effective as traditional methods of lecture for medical surgical content delivery since students receiving the most self-study scored significantly better on the posttest than those receiving the least amount. Furthermore, investigators found that students reported greater satisfaction with independent study due to the pace, ability to repeat content as needed, and flexibility compared to traditional lecture.

In 2004, Nehring and Lashley administered an international survey to 21 nursing schools to examine student opinions regarding the use of the human patient simulator (HS) in their nursing education. Data collection on student assessments of simulation for instruction

was gathered from evaluations, specific surveys, and verbal reports with open-ended questions soliciting student opinions. Analysis revealed students found simulation to be enjoyable, interactive, safe, practical, a means for content remediation, and realistic.

Analysis of the literature on opinions and nursing content revealed the finding that student and faculty opinions generate information about teaching and learning methods. Furthermore, the most common way that opinion data has been collected is from open-ended questions on surveys or questionnaires.

### **Summary**

Chapter 2 contains a review of the pertinent literature and research related to this study. Analysis revealed that evidence measuring student outcomes to guide nurse educators on the use of gaming simulation instruction is limited. However, findings are optimistic, establishing that, teaching/learning is positively impacted when simulation is used as an instructional strategy revealing student improvements in content retention, motivation, fun, problem-solving ability, accuracy, confidence, stress reduction, experience, realism, values, decision-making, and clinical skills. Research methods used to evaluate the cognitive learning of students engaged with simulation instruction included quasi-experimental and descriptive designs. However, no studies could be located exploring virtual clinical gaming simulation instruction applied using digital media software. Furthermore, research instruments measuring student achievement varied and psychometric information on the reliability and validity of the tools was rarely reported, impairing generalizations of findings. Implications of this review are that adoption of virtual clinical simulation instruction using educational gaming software suitable for today's digital native nursing students is impeded without further evidence on student learning of nursing content mastery areas due to the risks for negative consequences to students

and programs for poor NCLEX-RN<sup>®</sup> performance. The conclusion is that more research investigating the use of simulation instruction and its effects on student learning is needed, especially when it is applied using virtual clinical gaming simulation software.

## **CHAPTER THREE: RESEARCH METHODS**

Identification of the techniques and measures used to perform this research is the aim of this chapter. The research design, population and sample, intervention, instrumentation, and data analysis used to answer three research questions are described.

### **Research Questions**

The research questions addressed in this study were:

1. What are the differences in post-instruction exam achievement scores on the Assessment Technologies Institute Content Mastery Series 2.1 Medical-Surgical Exam™ among higher education medical-surgical nursing students taught with and without virtual clinical simulation instruction during the fall 2006 through fall 2008 semesters?
2. What are the differences in pre/post-instruction exam achievement scores on the Assessment Technologies Institute Content Mastery Series 2.1 Medical-Surgical Exam™ among higher education medical-surgical nursing students taught with and without virtual clinical simulation instruction during the fall 2008 semester?
3. What are the differences in pre/post-instruction perceived competence summative scores on the Medical-Surgical Nursing Self-Assessment Survey among higher education medical-surgical students who received virtual clinical simulation instruction during the fall 2008 semester?

### **Research Design**

A quantitative causal comparative descriptive design was used to address the research questions because all sought to describe the differences and infer causes in variables among



two or more groups (Burns & Grove, 2001) taught with and without virtual clinical simulation. Moreover, independent and dependent variables were determined for each research question to aid with description of the differences in variables among groups.

### ***Research Question One***

For research question one, the independent variable was instructional strategy manipulated by groups from the 2006 to 2008 semesters (i.e., after traditional (TI) or after virtual clinical simulation instruction (VCSI)). The dependent variable was achievement measured using the ATI CMS 2.1 MS Exam™ scores.

### ***Research Question Two***

Instructional strategy manipulated by groups (i.e., before/after TI and before/after VCSI) from the 2008 semester was the independent variable in research question two. The dependent variable was achievement measured using the ATI CMS 2.1 MS Exam™ scores.

### ***Research Question Three***

The independent variable was instructional strategy manipulated by groups (i.e., before/after VCSI) for research question three. Perceived competence was the dependent variable for research question three measured as summative scores (i.e., pre/post-VCSI perceived competence summative scores) from the Medical-Surgical Nursing Self-Assessment Survey (Appendix B).

## **Population and Sample**

The population for this study was 138 higher education undergraduate nursing students from one private university enrolled in medical-surgical nursing courses for the purpose of learning essential medical-surgical content, skills, and behaviors needed by entry-level nursing graduates during the fall 2006 through fall 2008 semesters. The sampling technique was non-

probability purposive sampling. A non-random sample of 98 fluent English speaking medical-surgical students with a grade point average (GPA) of 2.5 or greater in nursing who completed the ATI CMS 2.1 MS Exam™ during the fall 2006 through fall 2008 semesters was obtained and purposively placed into sample subgroups based on the instructional method used for delivering medical-surgical nursing content.

### ***Research Question One***

For research question one, the sample was 98 medical-surgical student subjects who received VCSI or TI from the fall 2006 through fall 2008 academic semesters. Subjects were part of four post-instruction sample subgroups including:

1. fall 2006 after TI group,  $n = 30$ ,
2. fall 2007 after VCSI group,  $n = 22$ ,
3. fall 2008 after TI control group,  $n = 29$ , and
4. fall 2008 after VCSI treatment group,  $n = 17$ .

### ***Research Question Two***

The sample for research question two was 46 medical-surgical student subjects who received VCSI or TI from the fall 2008 semester. Subjects were placed into pre- and post-instruction subgroups. The sample subgroups included:

1. fall 2008 before TI control group,  $n = 29$ ,
2. fall 2008 before VCSI treatment group,  $n = 17$ ,
3. fall 2008 after TI control group,  $n = 29$ , and
4. fall 2008 after VCSI treatment group,  $n = 17$ .

### ***Research Question Three***

The sample of subjects for research question three was 17 medical-surgical students who received VCSI from the fall 2008 semester. Subjects were placed into pre- and post-instruction sample subgroups. The sample subgroups were the:

1. fall 2008 before VCSI treatment group,  $n = 17$  and
2. fall 2008 after VCSI treatment group,  $n = 17$ .

### **Intervention**

The intervention in this study was VCSI used to deliver medical-surgical nursing content. The particular partial reality virtual clinical gaming simulation software used was Virtual Clinical Excursions (VCE) 3.0 a CD-ROM developed by Elsevier, Inc., specifically for the medical-surgical textbook adopted in a medical-surgical nursing education course. VCE 3.0 is an educational gaming package that contains 24-simulated multimedia enriched interactive virtual patient care practical application situations on a CD-ROM accompanied by a corresponding student guidebook and course textbook. Each simulation begins with reading and writing activities outlined in the guidebook that direct students to review content in the course textbook. At the conclusion of the guidebook exercises, students are directed to start the VCE 3.0 CD-ROM and select certain patients and/or timeframes to initiate an interactive virtual clinical simulation experience enriched with visual and auditory cues from patient and peer actors to apply the medical-surgical content just reviewed using the nursing process. VCE 3.0 is a computer-based 2D interactive partial virtual reality clinical simulation delivered using a computer screen, speakers, mouse and printer that stimulates at least two senses i.e., hearing and vision (Stanford University, 2009). Thus, VCE 3.0 aids students in developing critical

thinking skills and clinical judgment through realistic or practical application in nonclinical settings such as classrooms (Tashiro, 2006).

### **Instrumentation**

Data collection instruments used in this study included both an examination and a questionnaire. The examination used to collect data on student achievement for research questions one and two was the nationally normed standardized ATI CMS 2.1 MS Exam™ constructed from the NCLEX-RN® blueprint to assess student mastery of medical-surgical content that is tested on the NCLEX-RN® (ATI, 2004). The ATI CMS 2.1 MS Exam™ is considered a reliable and valid tool based on the following data. Using a group of 1,681 medical-surgical students, ATI initially calculated the Cronbach's alpha reliability coefficient to establish internal consistency of the instrument as  $\alpha = .695$  demonstrating sufficient internal reliability that the tool was dependable and consistent in measuring medical-surgical elements (ATI, 2004). Subsequently, the Cronbach's alpha reliability coefficient was recalculated by ATI two years later using a new group of 1,627 medical-surgical students and was found to be  $\alpha = .716$  again demonstrating a sufficient internal consistency or reliability of the tool (ATI, 2006).

In addition, validity of the tool was determined using construct and content validity methods. Construct validity was established by an extensive review of the NCLEX-RN® Test Plan (ATI, 2004; NCSBN, 2004, 2007). Content validity was determined using a panel of nursing experts and a sampling of nursing schools. Based on the findings from the construct and content validity reviews the instrument was determined to be valid for measuring medical-surgical content needs of nursing students (ATI, 2004).

The questionnaire used in this study to collect data for research question three was the Medical-Surgical Nursing Self-Assessment Survey. The Medical-Surgical Nursing Self-Assessment Survey is a researcher designed self-report questionnaire consisting of demographic queries, an open-ended item, and medical-surgical content information questions. Construct validity was determined by an extensive review of the NCLEX-RN<sup>®</sup> Test Plan. A panel of undergraduate nursing education experts including a school of nursing Dean, Program Chair, Doctoral Faculty Survey Researcher, and Medical-Surgical Nursing Faculty members, established content validity (Appendix C) .

### **Data Analysis**

Data were acquired from participant ATI CMS 2.1 MS Exam<sup>™</sup> scores for research questions one and two. In addition, data for research question three were gained from participant Medical-Surgical Nursing Self-Assessment Survey responses related to demographic information and medical-surgical content questions. Statistical analysis on gathered data was conducted using SPSS<sup>®</sup> 15.0.

### ***Research* Question One**

Data collected for research question one were analyzed using descriptive statistics and one-way analysis of variance (ANOVA) to determine significant differences in the post-instruction ATI CMS 2.1 MS Exam<sup>™</sup> mean scores among medical-surgical nursing students taught with or without VCSI during the fall 2006 to fall 2008 semesters. An effect size measure was computed because significance was found. Moreover, a mean score plot graphic and descriptive data frequencies and measures of central tendency tables were created to provide relevant visuals of the descriptive data output.

### ***Research Question Two***

The data acquired for research question two were analyzed using descriptive statistics and one-way ANOVA to determine significant differences in the pre-instruction and post-instruction ATI CMS 2.1 MS Exam™ scores among the treatment (VCSI) and control (TI) groups during the fall 2008 semester. A p value of .05 was set beforehand as the test of significance. An effect size measure was computed because significance was found. Relevant descriptive data frequencies and measures of central tendency were placed into tables to visualize output.

### ***Research Question Three***

Data for research question three were analyzed using descriptive statistics and two-related samples Wilcoxon matched-pairs signed-rank test. The two-related samples Wilcoxon matched pairs-signed rank test was used because the sample size was small ( $n = 17$ ) and Wilcoxon replaced observed differences with ranks, which offsets the severity of an effect for outliers, or large differences. Results of the descriptive analysis consisting of measures of central tendency were placed into a table to visualize output. Response data from one open-ended question on the Medical-Surgical Nursing Self-Assessment Survey were analyzed to identify common themes. Themes, reported as ancillary findings, were summarized.

### **Summary**

This chapter outlined the overall quantitative causal comparative design and research procedures that were used in this investigation. The research population for this study was higher education undergraduate nursing students from one private university enrolled in medical-surgical nursing courses for the purpose of learning essential medical-surgical content, skills and behaviors needed by entry-level nursing graduates from the fall 2006 through fall

2008 semesters. A non-random sample of 98 fluent English speaking medical-surgical students with a grade point average (GPA) of 2.5 or greater in nursing who completed the ATI CMS 2.1 MS Exam™ during the fall 2006 through fall 2008 semesters was used. Students were purposively placed into sample sub groupings. Data were collected from the standardized ATI CMS 2.1 MS Exam™ and the Medical-Surgical Nursing Self-Assessment Survey both constructed from the medical-surgical content found in the NCLEX-RN® Test Plan. Data analysis included statistical analysis of quantitative examination and questionnaire data. Relevant ancillary findings from participant responses to an open-ended item on the Medical-Surgical Nursing Self-Assessment Survey were also analyzed. Major findings and ancillary findings are reported in Chapter 4.

## **CHAPTER FOUR: FINDINGS**

This study was designed to determine whether the use of virtual clinical gaming simulation has an effect on the learning outcomes of medical-surgical nursing students. Descriptive data and statistical analysis are presented in this chapter for the following three research questions:

1. What are the differences in post-instruction exam achievement scores on the Assessment Technologies Institute Content Mastery Series 2.1 Medical-Surgical Exam™ among higher education medical-surgical nursing students taught with and without virtual clinical simulation instruction during the fall 2006 through fall 2008 semesters?
2. What are the differences in pre/post-instruction exam achievement scores on the Assessment Technologies Institute Content Mastery Series 2.1 Medical-Surgical Exam™ among higher education medical-surgical nursing students taught with and without virtual clinical simulation instruction during the fall 2008 semester?
3. What are the differences in pre/post-instruction perceived competence summative scores on the Medical-Surgical Nursing Self-Assessment Survey among higher education medical-surgical students who received virtual clinical simulation instruction during the fall 2008 semester?

### **Population and Sample**

The population for this study was 138 higher education undergraduate nursing students from one private university enrolled in medical-surgical nursing courses for the purpose of learning essential medical-surgical content, skills, and behaviors needed by entry-level nursing



graduates from the fall 2006 through fall 2008 semesters. The sampling technique was non-probability purposive sampling. A non-random sample of 98 fluent English speaking medical-surgical students with a grade point average (GPA) of 2.5 or greater in nursing who completed the ATI CMS 2.1 MS Exam™ was obtained and purposively placed into sample subgroups based on the instructional method used to deliver medical-surgical nursing content.

For research question one, the sample consisted of 98 medical-surgical student subjects who received virtual clinical simulation instruction (VCSI) or traditional instruction (TI) from the fall 2006 through fall 2008 semesters. Subjects were placed into four post-instruction sample subgroups including: fall 2006 after TI group ( $n = 30$ ), fall 2007 after VCSI group ( $n = 22$ ), fall 2008 after TI control group ( $n = 29$ ), and fall 2008 after VCSI treatment group ( $n = 17$ ).

The sample for research question two was 46 medical-surgical student subjects who received VCSI or TI from the fall 2008 semester. Subjects were placed into pre- and post-instruction subgroups including: fall 2008 before/after TI control groups ( $n = 29$ ) and fall 2008 before/after VCSI treatment groups ( $n = 17$ ).

The sample of subjects for research question three was 17 medical-surgical students who received VCSI during the fall 2008 semester. Subjects were placed into pre- and post-instruction sample subgroups: fall 2008 before/after VCSI treatment groups ( $n = 17$ ).

### **Major Findings**

Data were obtained from the standardized ATI CMS 2.1 MS Exam™ scores for research questions one and two and the Medical-Surgical Nursing Self-Assessment Survey (Appendix B) for research question three. Using SPSS® 15.0, the data were analyzed using descriptive and inferential statistics. Results for each research question are reported.

### ***Research Question One***

*What are the differences in post-instruction exam achievement scores on the Assessment Technologies Institute Content Mastery Series 2.1 Medical-Surgical Exam™ among higher education medical-surgical nursing students taught with and without virtual clinical simulation instruction during the fall 2006 through fall 2008 semesters?* In order to answer research question one, data from 98 medical-surgical student subjects were analyzed using descriptive statistics and one-way analysis of variance (ANOVA) to determine differences.

***Descriptive statistics.*** Fall 2006 through fall 2008 post-instruction ATI CMS 2.1 MS Exam™ results – mode, median, mean, and standard deviation – are displayed in Table 1. The fall 2006 after TI group mean score was 63.2 (*SD* 9.35). For the fall 2007 after VCSI group, the mean score was 69.9 (*SD* 8.33). For the fall 2008 after TI control group, the mean score was 54.9 (*SD* 5.65). The fall 2008 after VCSI treatment group mean score was 80.9 (*SD* 5.66). Other measures of central tendency – mode and median – revealed similar results. In each case, students taught with VCSI scored higher than those taught with TI.

**Table 1: Research Question One - Descriptive Statistics.**

Groups	<i>n</i>	Mode	Median	Mean	<i>SD</i>
Fall 2006 after TI	30	60.0	61.7	63.2	9.35
Fall 2007 after VCSI	22	63.3	67.3	69.9	8.33
Fall 2008 after TI Control	29	51.1 54.4 56.7 57.8 58.9	55.6	54.9	5.65
Fall 2008 after VCSI Treatment	17	76.7 78.9 83.3	78.9	80.9	5.66
Total Post-Instruction	98	60.0	63.3	65.3	11.68

***One-way analysis of variance.*** Data were analyzed using one-way ANOVA to determine if differences between groups were significant. The hypotheses were:

1. Null hypothesis: There are no differences in the post-instruction achievement mean scores on the ATI CMS 2.1 MS Exam™ among higher education medical-surgical nursing students taught with and without VCSI during fall 2006 through fall 2008 semesters.
2. Alternate hypothesis: There are differences in the post-instruction achievement mean scores on the ATI CMS 2.1 MS Exam™ among higher education medical-surgical nursing students taught with and without VCSI instruction during the fall 2006 through fall 2008 semesters.

Levene's test of homogeneity was obtained to determine equal variance among groups. Based on the  $p = .148$ , homogeneity of variance was assumed. The obtained  $F$  ratio (45.490)

shown in Table 2, reveals a significant effect among the groupings. The magnitude of that effect was moderately large as noted by the Eta Squared of .592.

**Table 2: Research Question One - ANOVA.**

Groups	SS	df	Mean Square	F	Sig.	Eta Squared
Between Groups	7838.296	3	2612.765	45.490	.000*	.592
Within Groups	5398.931	94	57.435			
Total	13237.227	97				

\*Significant at the .05 level.

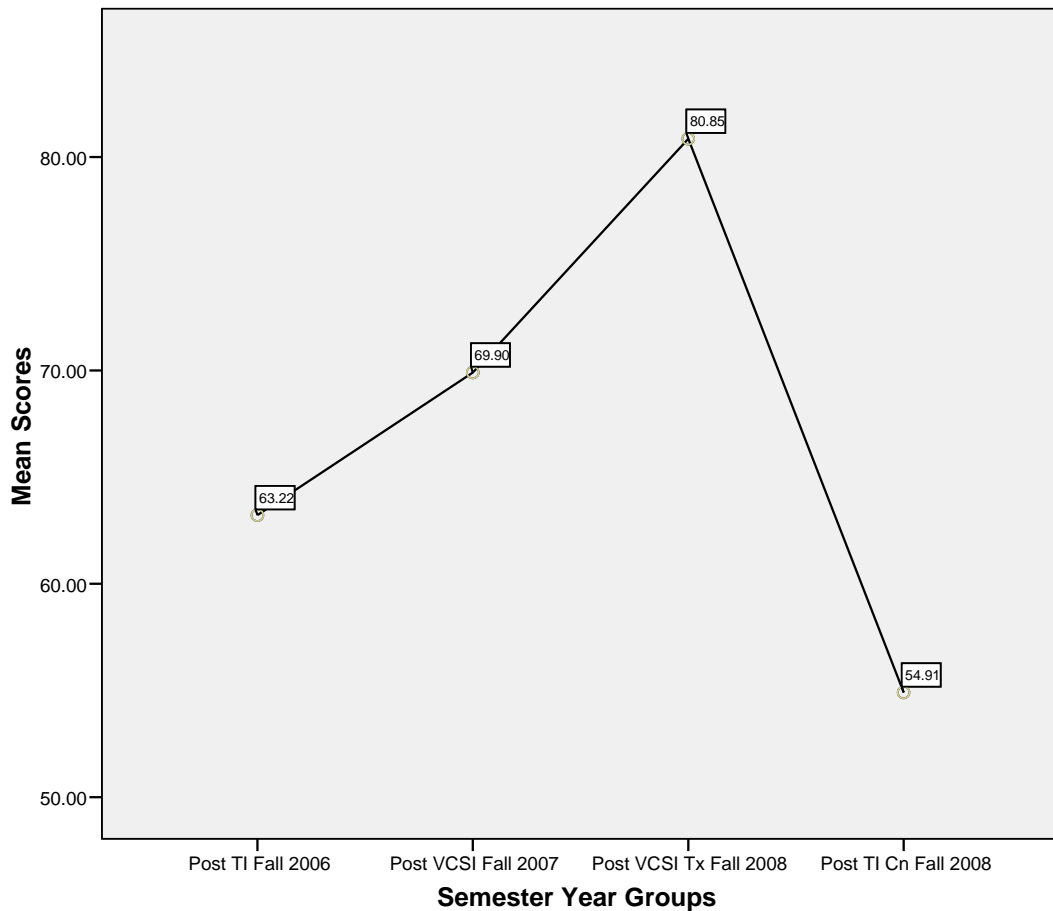
To know which of the groups were significantly different, a post hoc comparison was obtained using the Bonferroni procedure. Note these effects in Table 3. There were significant differences between the fall 2006 and fall 2008 TI groups ( $p = .000$ ) and between the fall 2007 and fall 2008 VCSI groups ( $p = .000$ ). Significant differences were also found when post-instruction TI groups (fall 2006 and fall 2008) were compared to post-instruction VCSI groups (fall 2007 and fall 2008). The smallest difference in post-instruction scores was between the fall 2006 TI and fall 2007 VCSI groups ( $p = .013$ ).

**Table 3: Research Question One - Bonferroni Post Hoc Test.**

(I)Semester Year	(J)Semester Year	Mean Difference (I-J)	SE	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Fall 2006 (TI)	Fall 2007 (VCSI)	-6.6833	2.1273	.013*	-12.417	-.950
	Fall 2008 (VCSI)	-17.6363	2.3007	.000*	-23.837	-11.435
	Fall 2008 (TI)	8.3063	1.9736	.000*	2.987	13.626
Fall 2007 (VCSI)	Fall 2008 (VCSI)	-10.9529	2.4473	.000*	-17.549	-4.357
	Fall 2008 (TI)	14.9897	2.1427	.000*	9.215	20.765
Fall 2008 (VCSI)	Fall 2008 (TI)	25.9426	2.3150	.000*	19.703	32.182

\* Significant at the .05 level.

In summary, one-way ANOVA and Bonferroni post hoc tests reveal that there is a significant difference in post-instruction ATI CMS 2.1 MS Exam™ scores among students taught with and without VCSI from fall 2006 to fall 2008. Therefore, the null hypothesis was rejected, and the alternate hypothesis was accepted. Further exploration of post-instruction group mean score data, conveyed in Figure 1, illustrates that students taught with VCSI earned higher group mean scores (69.9 in 2007 and 80.9 in 2008) than those taught by TI (63.2 in 2006 and 54.9 in 2008).



**Figure 1: Research Question One - Mean Score Plot.**

## ***Research Question Two***

*What are the differences in pre/post-instruction exam achievement scores on the Assessment Technologies Institute Content Mastery Series 2.1 Medical-Surgical Exam™ among higher education medical-surgical nursing students taught with and without virtual clinical simulation instruction during the fall 2008 semester?* The sample for research question two consisted of 46 medical-surgical student subjects who were taught with TI ( $n = 29$ ) or VCSI ( $n = 17$ ) during the fall 2008 semester. Descriptive statistics and one-way ANOVA were completed to determine differences.

***Descriptive statistics.*** Pre- and post-instruction ATI CMS 2.1 MS Exam™ results – mode, median, mean and standard deviation – from fall 2008 control and treatment groups are displayed in Table 4. The mean score for the fall 2008 before TI control group was 51.2 ( $SD$  6.33). The fall 2008 before VCSI treatment group averaged 56.4 ( $SD$  8.42). The fall 2008 after TI control group had a mean score of 54.9 ( $SD$  5.65). The fall 2008 after VCSI treatment group mean score was 80.9 ( $SD$  5.66). Other measures of central tendency, including the mode and median, revealed the same pattern; students taught with VCSI scored higher than those taught with TI.

**Table 4: Research Question Two - Descriptive Statistics.**

Groups	<i>n</i>	Mode	Median	Mean	<i>SD</i>
Fall 2008 Before TI Control Group	29	47.9 48.9	50	51.2	6.33
Fall 2008 Before VCSI Treatment Group	17	53.3 58.9 62.2 65.6	58.9	56.4	8.42
Fall 2008 After TI Control Group	29	51.1 54.4 56.7 57.8 58.9	55.6	54.9	5.65
Fall 2008 After VCSI Tx Group Mean Score	17	76.7 78.9 83.3	78.9	80.9	5.66

***One-way analysis of variance.*** Data were analyzed using one-way ANOVA to determine if differences between groups were significant. The hypotheses were:

1. Null hypothesis: There are no differences in the pre/post-instruction achievement mean scores on the ATI CMS 2.1 MS Exam™ among higher education medical-surgical nursing students taught with and without VCSI from the fall 2008 semester.
2. Alternate hypothesis: There are differences in the pre/post-instruction achievement mean scores on the ATI CMS 2.1 MS Exam™ among higher education medical-surgical nursing students taught with and without VCSI instruction from the fall 2008 semester.

Levene's test of homogeneity was obtained to determine equal variance among groups. Based on the  $p = .113$  homogeneity of variance was assumed. The obtained  $F$  ratio (83.992)

shown in Table 5, reveals a significant effect among the groupings. The magnitude of that effect was large as noted by the Eta Squared of .714.

**Table 5: Research Question Two - ANOVA.**

Groups	SS	df	Mean Square	F	Sig.	Eta Squared
Between Groups	10486.968	3	3495.656	83.992	.000*	.714
Within Groups	3662.471	88	41.619			
Total	14149.438	91				

\*Significant at the .05 level.

To know which of the groups were significantly different a post hoc comparison was obtained using the Least Significant Difference (LSD). Note these effects in Table 6. Analysis shows that there were significant differences between students in the VCSI treatment group and TI control group before instruction ( $p = .010$ ). There were also significant differences in scores received by VCSI and TI groups after instruction ( $p = .000$ ). Further review shows that both TI ( $p = .030$ ) and VCSI ( $p = .000$ ) groups made significant gains between pre- and post-examination. Although, the level of significance was greater for students taught with VCSI. Scores for the pre-instruction VCSI treatment group and post-instruction TI control group were non-significant.

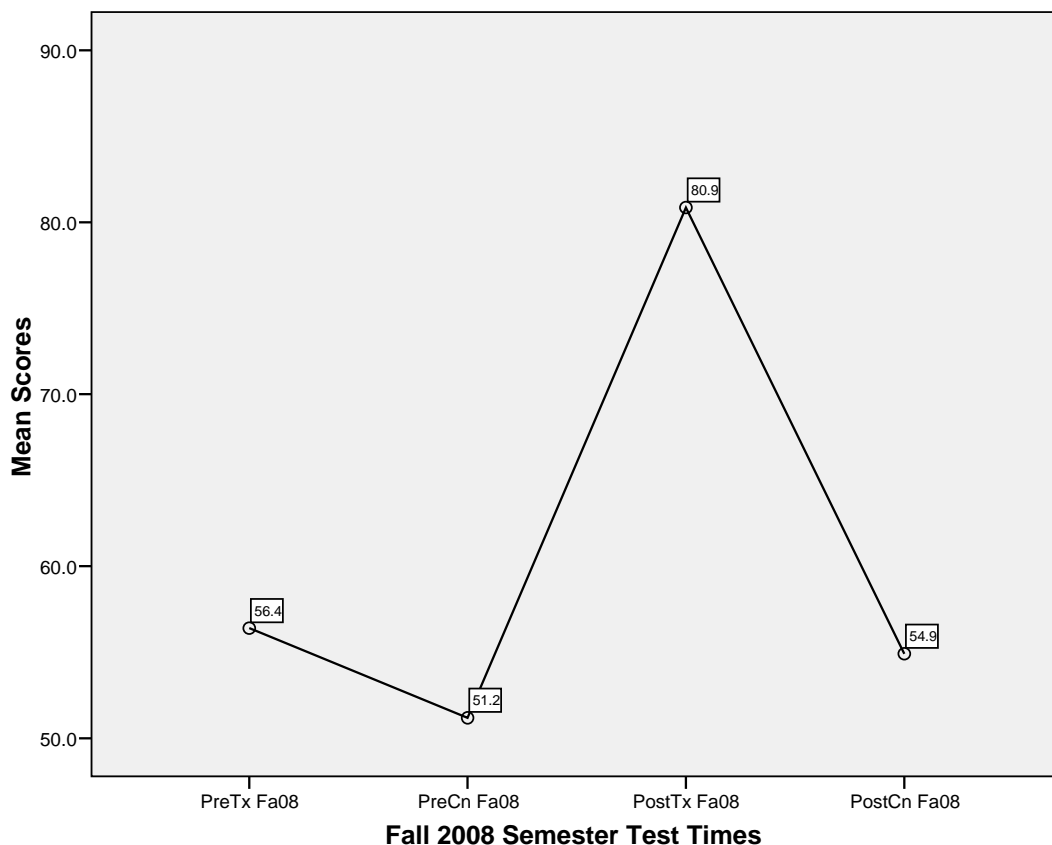


**Table 6: Research Question Two - Least Significant Difference (LSD) Post Hoc Test.**

(I)Semester Year	(J)Semester Year	Mean Difference (I-J)	SE	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Pre Fall 2008 (VCSI)	Pre Fall 2008 (TI)	5.2172	1.9706	.010*	1.301	9.133
	Post Fall 2008 (VCSI)	-24.4529	2.2128	.000*	-28.850	-20.056
	Post Fall 2008 (TI)	1.4897	1.9706	.452	-2.427	5.406
Pre Fall 2008 (TI)	Post Fall 2008 (VCSI)	-29.6702	1.9708	.000*	-33.586	-25.754
	Post Fall 2008 (TI)	-3.7276	1.6942	.030*	-7.094	-.361
Post Fall 2008 (VCSI)	Post Fall 2008 (TI)	25.9426	1.9706	.000*	22.026	29.859

\*Significance at the .05 level.

In summary, one-way ANOVA and LSD post hoc tests reveal that there are significant differences in pre- and post-instruction ATI CMS 2.1 MS Exam™ scores among students taught with and without VCSI during fall 2008. Specifically, there were significant differences between students in the VCSI treatment group and TI control group before instruction ( $p = .010$ ) and after instruction ( $p = .000$ ). Additionally, both TI ( $p = .030$ ) and VCSI ( $p = .000$ ) groups made significant gains between pre- and post-examination, but the level of significance was greater for students taught with VCSI. Therefore, the null hypothesis was rejected and the alternate hypothesis was accepted. Further exploration of post-instruction group mean score data, conveyed in Figure 2, illustrates that students taught with VCSI earned higher group mean scores than those taught by TI. Specifically, means scores for the treatment group increased by 24.5 points (from 56.4 to 80.9), while students in the TI control group only gained 3.7 points (from 51.2 to 54.9) between pre- and post-examination.



**Figure 2: Research Question Two - Mean Score Plot.**

### ***Research Question Three***

*What are the differences in pre/post-instruction perceived competence summative scores on the Medical-Surgical Nursing Self-Assessment Survey among higher education medical-surgical students who received virtual clinical simulation instruction during the fall 2008 semester?* Data were collected for research question three from the pre- and post-instruction Medical-Surgical Nursing Self-Assessment Survey completed by 17 baccalaureate medical-surgical student subjects. The mean age was 26 (*SD* 7.04) with a median age of 22. The mean years of gaming experience was seven (*SD* 5.87) and the median was four. Students also identified their preferred learning style as “Doing” (88.2%) when asked to select between

“Doing”, “Hearing” (0%) and “Seeing” (11.8%). Survey results were analyzed using descriptive statistics and the two-related samples Wilcoxon matched-pairs signed-rank test.

**Descriptive statistics.** Based on students’ Medical-Surgical Self-Assessment Survey pre- and post-instruction perceived competency summative scores (mode, median, mean and standard deviations) are displayed in Table 7. Scores are based on a rating scale of 1 = none, 2 = low competence, 3 = moderately low competence, 4 = moderately high competence, and 5 = high competence. The pre-instruction VCSI treatment group perceived competence mode was 4, median was 4, and mean was 3.47 ( $SD = .717$ ). As noted by a mean score of 3.47, students perceived their competence as moderately low prior to instruction. The post-instruction VCSI treatment group perceived competence mode was 5, median was 5, and mean was 4.82 ( $SD = .393$ ). Based on the mean score of 4.82, students felt they had achieved high competence in medical-surgical content.

**Table 7: Research Question Three - Descriptive Statistics.**

	<i>n</i>	Mode	Median	Mean	<i>SD</i>
Fall 2008 Before-VCSI Treatment Group	17	4	4	3.47	.717
Fall 2008 After-VCSI Treatment Group	17	5	5	4.82	.393

**Two-related samples Wilcoxon matched-pairs signed-rank test.** Data were analyzed using the two-related samples Wilcoxon matched-pairs signed-rank test to determine the size of the difference in mean ranks among paired subjects. The hypotheses were:

1. Null hypothesis: The mean rank is similar among the pre- and post-instruction groups perceived competency Medical-Surgical Nursing Self-Assessment Survey summative scores during the fall 2008 semester.
2. Alternate hypothesis: The mean rank is not similar among the pre- and post- instruction groups perceived competency Medical-Surgical Nursing Self-Assessment Survey summative scores during the fall 2008 semester.

**Table 8: Research Question Three - Mean Rank.**

		<i>n</i>	Mean Rank	Sum of Ranks
After VCSI				
Perceived Competency Score	Negative Ranks	0	.00	.00
Before VCSI				
Perceived Competency Score	Positive Ranks	17	9.00	153.00
	Ties	0		
	Total	17	9.00	153.00

The positive ranks or cases for which the post-instruction perceived competency summative score increased over the pre-instruction perceived competency score was 17 and the mean rank was nine (see Table 8). There were no reported negative ranks or ties. The obtained *z* statistic was -3.758 (displayed in Table 9) revealing a significant effect ( $p = .000$ ) between pre- and post-instruction.

**Table 9: Research Question Three -Two-Related Samples Wilcoxon Matched-Pairs Signed-Rank Test.**

After VCSI PCS Group – Before VCSI PCS Group	
Z	-3.758
Asymp. Sig. (2 –tailed)	.000*

\*Significant at the .05 level.

In summary, the two-related samples Wilcoxon matched-pairs signed-rank test reveals that there was a significant difference in students' perceptions of competence between pre- and post-instruction. Furthermore, the gains were all positive with students indicating an increase from moderately low competence (3.47) before instruction to high competence (4.82) after instruction. Therefore, the null hypothesis was rejected and the alternate hypothesis was accepted.

### Ancillary Findings

Students in the VCSI treatment group responded to the following open-ended question located on the Medical-Surgical Nursing Self-Assessment Survey: “In your opinion, how has virtual clinical gaming simulation affected your learning of medical-surgical content?” Thirteen of 17 or 76.4% of students in the VCSI treatment group responded (see Table 10).

**Table 10: Ancillary Findings - Student Opinion Analysis.**

<i>n</i>	Missing	Total	Themes	Frequency	Percent
17	4	13	Experience	10	76.6%
			Understanding	7	53.9%
			Safety	4	30.8%
			Enjoyment	3	23.1%
			Convenience	2	15.4%
			Motivation	1	7.7%

The most frequently reported benefit was experience mentioned by 10 of 13 students (76.6%). Experience was expressed as doing or practice. For example, one student reported that

virtual clinical simulations (VCS) “give me a chance to learn by doing without the fear of harming someone. They really helped me learn the medical-surgical content.” Another reported that VCS “helped me to practice skills, be flexible and learn from my mistakes.”

Understanding was the second most frequent benefit conveyed by seven of 13 students (53.9%) in the VCSI treatment group. For example, one student reported, “virtual clinical simulation games have had a great influence on my understanding of medical-surgical content”. The other emergent but less frequently stated themes were that VCSI promoted safety, convenience, enjoyment, and motivation. Many student comments cut across themes. For example, in this comment, “I got to practice at home which makes it convenient, better to make mistakes in the game because it’s safer than in a live clinical!” both the themes of convenience and safety were highlighted.

### **Summary of Findings**

This chapter reported findings from the descriptive and inferential statistical analysis of data collected from the ATI CMS 2.1 MS Exam™ and the Medical-Surgical Nursing Self-Assessment Survey to answer the three research questions. Research question one findings from the one-way ANOVA shows the differences between TI and VCSI are statistically significant ( $p = .000$ ) with post hoc analysis revealing significance between each group. Further review of mean scores and other measures of central tendency shows that students taught with VCSI scored significantly higher than TI students from fall 2006 through fall 2008 semesters. The effect of VCSI accounted for 59.2% of the total variability. Research question two findings from the one-way ANOVA shows the differences between TI and VCSI are statistically significant ( $p = .000$ ) with post hoc analysis revealing significance between pre-instruction groups (TI versus VCSI), between post-instruction groups (TI versus VCSI), and

between pre- and post-instruction groups (TI versus TI and VCSI versus VCSI). Further review of mean scores and other measures of central tendency shows that students taught with VCSI scored significantly higher than TI students during the fall 2008 semester. The effect of VCSI accounted for 71.4% of the total variability. Research question three findings show that differences in pre- and post-instruction perceived competence summative scores of students who received VCSI during the fall 2008 semester increased significantly for all students. Finally, ancillary findings from thematic analysis of student responses to an open-ended question revealed the most frequent benefits of VCSI to learning were experience and understanding. Other reported, but less frequently mentioned, themes were safety, enjoyment, convenience, and motivation.

## **CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

The purpose of this study was to determine if the use of the instructional strategy of virtual clinical simulation instruction (VCSI) to deliver medical-surgical content had a significant effect on the learning outcomes of students in higher education medical-surgical nursing education courses. The specific student learning outcomes of medical-surgical content exam achievement scores and perceived competency were explored for differences with the following three research questions:

1. What are the differences in post-instruction exam achievement scores on the Assessment Technologies Institute Content Mastery Series 2.1 Medical-Surgical Exam™ among higher education medical-surgical nursing students taught with and without virtual clinical simulation instruction during the fall 2006 through fall 2008 semesters?
2. What are the differences in pre/post-instruction exam achievement scores on the Assessment Technologies Institute Content Mastery Series 2.1 Medical-Surgical Exam™ among higher education medical-surgical nursing students taught with and without virtual clinical simulation instruction during the fall 2008 semester?
3. What are the differences in pre/post-instruction perceived competence summative scores on the Medical-Surgical Nursing Self-Assessment Survey among higher education medical-surgical students who received virtual clinical simulation instruction during the fall 2008 semester?



## **Population and Sample**

The population for this study was 138 higher education undergraduate nursing students from one private university enrolled in medical-surgical nursing courses for learning essential medical-surgical content, skills and behaviors needed by entry-level nursing graduates from the fall 2006 through fall 2008 semesters. The sampling technique was non-probability purposive sampling. A non-random sample of fluent English speaking medical-surgical students with a grade point average (GPA) of 2.5 or greater in nursing who completed the ATI CMS 2.1 MS Exam™ was obtained and purposively placed into sample subgroups based on the instructional method used to deliver medical-surgical nursing content.

For research question one, the sample consisted of 98 medical-surgical student subjects who received VCSI or traditional instruction (TI) from the fall 2006 through fall 2008 semesters. Subjects were placed into four post-instruction sample subgroups including: fall 2006 after TI group ( $n = 30$ ), fall 2007 after VCSI group ( $n = 22$ ), fall 2008 after TI control group ( $n = 29$ ), and fall 2008 after VCSI treatment group ( $n = 17$ ).

The sample for research question two was 46 medical-surgical student subjects who received VCSI or TI from the fall 2008 semester. Subjects were placed into pre- and post-instruction subgroups including: fall 2008 before/after TI control groups ( $n = 29$ ) and fall 2008 before/after VCSI treatment groups ( $n = 17$ ).

The sample of subjects for research question three was 17 medical-surgical students who received VCSI during the fall 2008 semester. Subjects were placed into pre- and post-instruction sample subgroups: fall 2008 before/after VCSI treatment groups ( $n = 17$ ).

## **Methods**

A causal-comparative descriptive research design was used for this study. Partial reality virtual clinical simulation using the computer-based gaming simulation software Virtual Clinical Excursions 3.0 by Elsevier was the intervention. The independent variable was the type of instructional method (i.e., TI or VCSI) used to deliver medical-surgical content to students. The dependent variables were the student learning outcomes of achievement (i.e., ATI CMS 2.1 MS Exam™ scores) for research questions one and two and perceived competence (i.e., Medical-Surgical Nursing Self-Assessment Survey perceived competency summative scores) for research question three.

## **Summary of Findings**

For research question one the one-way ANOVA and Bonferroni post hoc tests revealed that medical-surgical students taught with VCSI had significantly different content mastery post-instruction mean scores than groups taught with TI ( $p = .000$ ) from the fall 2006 through fall 2008 semesters. Additional exploration of post-instruction group mean score data, conveyed that students taught with VCSI earned higher group mean scores (69.9 in 2007 and 80.9 in 2008) than those taught by TI (63.2 in 2006 and 54.9 in 2008). The effect of VCSI on mean scores accounted for 59.2% of the total variability.

Regarding research question two the one-way ANOVA and LSD post hoc tests revealed that there were significant differences in pre- and post-instruction ATI CMS 2.1 MS Exam™ scores among students taught with and without VCSI from fall 2008. Specifically, there were significant differences between students in the VCSI treatment group and TI control group before instruction ( $p = .010$ ) and after instruction ( $p = .000$ ). Additionally, both TI ( $p = .030$ ) and VCSI ( $p = .000$ ) groups made significant gains between pre- and post-examination, but the

level of significance was greater for students taught with VCSI. Further exploration of group mean score data illustrated that students taught with VCSI earned higher group mean scores than those taught by TI. Specifically, mean scores for the treatment group increased by 24.5 points (from 56.4 to 80.9), while students in the TI control group only gained 3.7 points (from 51.2 to 54.9) between pre- and post-examination. The effect of VCSI on mean scores accounted for 71.4% of the total variability between VCSI and TI groups.

For research question three the two-related samples Wilcoxon matched-pairs signed-rank test revealed that there was a significant difference ( $p = .000$ ) in students' perceptions of competence between pre- and post-instruction. Furthermore, the gains were all positive with students indicating an increase from moderately low competence (3.47 out of 5) before instruction to high competence (4.82 out of 5) after instruction.

Ancillary findings from an open-ended student opinion question provided students' perceptions regarding benefits of learning with VCSI. The most frequently mentioned advantages were categorized as experience and understanding. Experience was expressed as doing or practice, articulated as VCS "give[s] me a chance to learn by doing without the fear of harming someone. They really helped me learn the medical-surgical content." The link of understanding to learning was conveyed in comments like this: "virtual clinical simulation games have had a great influence on my understanding of medical-surgical content." Other expressed benefits related to issues of safety, convenience, enjoyment, and motivation.

### **Findings Related to the Literature**

Findings from this study were compared to published investigations exploring gaming instruction, simulation instruction and gaming simulation instruction. The review revealed other studies with similar and dissimilar results.

### ***Major Findings***

Research questions one and two in this study revealed that students taught with VCSI had significantly higher post-instruction content mastery scores than students taught with TI. These findings were similar to other studies reporting significant differences in post-instruction content mastery or comprehension results in groups taught with simulation instruction (Alinier et al., 2006; Farnsworth et al., 2000) and gaming instruction (Cessario, 1987; Cowen & Tesh, 2002). Furthermore, for research question three, this examination discovered that medical-surgical nursing students' perceived their competency to be significantly higher after instruction. This was also similar to other studies that established that student beliefs about content learning or knowledge were increased after receiving nursing curriculum delivered with simulation instruction (Bearnson & Wiker, 2005; Bremner et al., 2006) and gaming instruction (Sisson & Becker, 1988).

The finding that students taught with VCSI had significantly higher post-instruction content mastery scores than students taught with TI also differ from a few studies. For instance, some investigations exploring differences in groups taught with gaming instruction and TI found no significant difference in post-exams (Bays & Hermann, 1997; Ingram et al., 1998) or that TI instruction groups scored significantly higher than gaming instruction groups on post-exams (Montpas, 2004).

### ***Ancillary Findings***

Student opinion analysis of responses to the open-ended survey question revealed six benefits of VCSI to learning: experience, understanding, safety, convenience, enjoyment, and motivation. These findings are similar to other studies where doing or practice of nursing using the nursing process and technical skills were acknowledged by students taught with simulation

instruction (Bearnson & Wiker, 2005; Bremner et al., 2006; Feingold et al., 2004; Kidd & Kendall, 2006; Morton, 1997; Nehring et al., 2001; Nehring & Lashley, 2004) and gaming instruction (Ward & O'Brien, 2005). Additionally, other studies also found that student understanding or cognitive knowledge was significantly improved with gaming instruction (Berbiglia et al., 1997; Gruending et al., 1991; Royse & Newton, 2007; Sisson & Becker, 1988) and simulation instruction (Morton, 1997; Nehring & Lashley, 2004; Rodgers, 2007). Safety or safe environments were connected with simulation instruction (Aronson et al., 1997; Larew et al., 2006; Morton, 1997; Nehring & Lashley, 2004) and gaming instruction (Gruending et al., 1991; Henry, 1997; Schmitz et al., 1991; Ward & O'Brien, 2005). Enjoyment, fun, and relaxation comments were linked with simulation instruction (Aronson et al., 1997; Nehring & Lashley, 2004; Rowell & Spielvogle, 1996) and gaming instruction (Berbiglia et al., 1997; Cessario, 1987; Gruending et al., 1991; Henry, 1997; Kuhn, 1995; Sisson & Becker, 1988; Ward & O'Brien, 2005). Finally, other research confirms that motivation was associated with the use of gaming instruction (Cessario, 1987; Royse & Newton, 2007; Walljasper, 1982).

Benefits to learning not identified in this study but discussed in other studies were found. For example, a simulation was deemed an event that fosters decision-making or critical thinking skills (Bremner et al., 2006; Butler et al., 2007; Feingold et al., 2004; Kidd & Kendall, 2006; Nehring and Lashley, 2004), boosts confidence (Bremner et al., 2006), and stimulates interest for specialty practice similar to the experienced event (Butler et al., 2007). Additionally, simulation instruction is a means for a structured (Larew et al., 2006) or varied multimedia environment (Agazio et al., 2002) where feedback (Agazio et al., 2002), communication and reflection (Kidd and Kendall, 2006) emerge. Gaming instruction experience promoted learning from involvement and interaction (Kuhn, 1995; Nehring &

Lashley, 2004; Ward & O'Brien, 2005), diversity (Henry, 1997), feedback (Henry, 1997), attentiveness (Kuhn, 1995) and critical thinking (Kuhn, 1995). Gaming instruction affects learning by stimulating thinking from competition, cooperation, creativity and variety (Berbiglia et al., 1997). Another study discovered learning was affected through technical skill practice and critical event management with simulation instruction (Nehring & Lashley, 2004). Simulation instruction was linked to collaborative inquiry, critical thinking, decision-making, and problem solving (Aronson et al., 1997).

Detriments to learning were not found in this inquiry. However, other studies have been completed that identify learning impediments with simulation and gaming instruction such as: stress, time intensity, inconsistency as an evaluation tool, competition, high development costs, and reliance upon orientation and debriefing periods (Bremner et al., 2006, Haskvitz & Koop, 2004, Kuhn, 1995).

### **Conclusions**

Effect sizes, ranging from 59 to 71% indicate that a considerable portion of content mastery variability can be attributed to the intervention – virtual clinical simulation instruction using digital media software. Since similar results were found from other gaming simulation instruction studies (Alinier et al., 2006; Cessario, 1987; Cowen & Tesh, 2002; Farnsworth et al., 2000) support exists for integrating this method in nursing classrooms to provide practical experiences related to teaching/learning essential medical-surgical skills and content. However, no evidence was found in this study or in related literature exploring virtual clinical simulation instruction to deliver other nursing curriculum content.

In addition to scoring well on the medical-surgical content mastery exam, student nurses perceived that their achievement would be high. It may be concluded that while the

acquisition of a professional content knowledge base is no doubt a major training objective, the related perceptions and beliefs about one's ability and motivation to acquire learning are important interactive effects that merit future perception and opinion research.

Lastly, all students reported positive open comments regarding the benefits of virtual clinical simulation instruction to their learning, and no detriments were identified. In short, it can be concluded that since differential assessments of professional knowledge and competence indicate the growth of medical-surgical nursing knowledge by these undergraduates then it provides additional support for using the method.

### **Implications**

Today's nursing students are digital natives who prefer learning similar to the way they have gained information in life, interactively, using digital technology enriched with audio, visual, and kinesthetic media different from previous generations. These contemporary students are also adult learners who like practical experience with new content delivery similar to previous generations of students. Software like Virtual Clinical Excursions 3.0 (VCE) by Elsevier, Inc. that stimulates hearing and visual senses with multimedia for practical application in medical-surgical nursing courses should be appealing to digital native adult learners.

Additionally, the findings of this study contributed to a developing knowledge base in nursing education literature regarding the effects of VCSI on student achievement and perceived competence in medical-surgical content mastery by adding new information to the body of evidence related to gaming simulation instruction. Furthermore, nursing stakeholders (i.e., nursing education accreditors, administrators, program chairs and faculty) responsible for decision-making on whether to adopt VCSI for use to deliver nursing curriculum can empower themselves with evidence-based results from this study in their decision-making.

The results from this study imply that:

1. Nursing instructors who teach medical-surgical nursing content knowledge using VCSI resources can increase the probability that their students will have greater content retention and related understanding of essential nursing knowledge. This is an important basis for future applications and synthesis of such concepts in day-to-day nursing practice.
2. There appears to be a concurrent, affective effect or by product of VCSI training related to virtual experiences, which engage all of one's senses in the learning context. An increased sense of self-efficacy may emerge from "doing nursing" via virtual clinical simulation or related kinds of resources.
3. Additionally, teachers can promote psychomotor learning and the technical skills, tasks, and procedures of medical-surgical nursing using VCSI. This consequence is based on the finding in this study that partial virtual reality clinical simulations were reported by students as safe, convenient, and motivating learning environments for repeated practice and doing of skills, independent of instructor and clinical laboratory availability.

### **Recommendations for Future Studies**

The findings of this study are significant but limited, providing opportunity for additional research. Recommendations for future study include:

1. Purposive sampling resulted in small and varied disproportional sample sizes for sub groups. Conducting future studies using random sampling techniques with larger and proportional sample sizes would aid in generalizing findings to other nursing populations.



2. The partial virtual reality clinical simulation used in this study stimulated the senses of hearing and vision and is only one kind of virtual reality simulation. Additional studies are needed using other partial reality or full reality virtual clinical simulations to determine if there are differences in student learning when two different, or more than two, senses are stimulated.
3. Virtual Clinical Excursions 3.0 for medical-surgical nursing content is only one version of this type of software for delivering nursing content with VCSI. More studies using VCE software versions for other nursing content areas like newborn nursing, mental health nursing, and pediatric nursing are needed to determine the effects on student learning in these content areas to build the body of evidence on the method.
4. Results of this study revealed a significant increase in student achievement on the standardized ATI CMS 2.1 MS Exam™ for students instructed on medical-surgical content with VCSI compared to TI. Future studies using other standardized ATI content mastery series exams for students instructed with VCSI on other nursing content areas required for entry-level practice and tested on NCLEX-RN® are needed to build the body of evidence in best-educational practices in nursing education.
5. Undergraduate higher education medical-surgical nursing students from one private university were used as the subjects in this study, limiting generalizability of the findings. Replication of this study using other medical-surgical nursing student samples like those found in diploma programs, practical nurse programs, community colleges, and public higher education institutions would aid in generalizing findings.
6. Future studies are needed to explore explained and unexplained variance in ATI CMS 2.1 MS Exam™ means scores identified in this study among pre- and post-instruction

groups taught with VCSI and TI. Identifying factors associated with student learning and achievement in mastering essential content in nursing curriculum would further benefit nursing education stakeholders with decision-making related to adopting instructional practices and methods that facilitate competence in entry-level nursing practice.

7. Further research is needed to establish the reliability of the Medical-Surgical Nursing Self-Assessment Survey instrument in other studies exploring medical-surgical nursing perceived competence.
8. More research with different and larger samples may uncover additional benefits or detriments of VCSI to learning not expressed by those in this study.

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## APPENDICES

## **APPENDIX A: PARTICIPANT LETTER**



Dear Student:

In an effort to learn more about the effects of the teaching strategies used in your medical-surgical nursing course, please complete the attached survey. There are two sections to this survey. In the first part, respond to general questions about who you are. For the second part, rate your current competence level in medical-surgical nursing practice. The purpose of the survey is to collect data for my dissertation research study.

This survey will take approximately 10 minutes to complete. Participation is voluntary and your consent is implied by your response. The information you supply is confidential. The results of the survey will be determined by the answers you provide and not by any personal information. Individual responses will not be identified. Data will be reported in aggregate form.

The results from this survey will assist in determining best educational strategies to use in teaching medical-surgical nursing. If you have additional questions about the study, please contact me Robin Lewis at 304-357-4837 or by email at [robinlewis@ucwv.edu](mailto:robinlewis@ucwv.edu). If you have questions concerning your rights as a research participant, you may contact the Marshall University Office of Research Integrity at 696-4303.

Sincerely,

Robin A. Lewis, MSN, FNP-BC, CCRN, RN  
Graduate Student  
Marshall University Graduate College

## **APPENDIX B: PARTICIPANT SURVEY**

# Medical-Surgical Nursing Self-Assessment Survey

## Part I. Demographic Information

Please respond to the following general questions about who you are.

1. How old are you? \_\_\_\_\_

2. How many years have you played video games? \_\_\_\_\_

3. How do you prefer to learn? Check One

Doing  
Hearing  
Seeing

4. In what type of undergraduate nursing education program are you enrolled?

Check One

Associate  
Baccalaureate  
Diploma

5. In your opinion, how has virtual clinical gaming simulation affected your learning of medical surgical content?

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Continue to the next page→.

## Part II. Competence Level Information

Using the scale below, *circle* the number after each statement that best corresponds to your current level of skill in medical-surgical nursing practice.

**1 = None**

**2 = Low competence**

**3 = Moderately low competence**

**4 = Moderately high competence**

**5 = High competence**

	None	Low	Moderately Low	Moderately High	High
1. Perform a nursing assessment.	1	2	3	4	5
2. Perform safe medication administration.	1	2	3	4	5
3. Perform patient education.	1	2	3	4	5
4. Prioritize patient care.	1	2	3	4	5
5. Delegate patient care.	1	2	3	4	5
6. Develop a nursing care plan.	1	2	3	4	5
7. Participate in performance improvement.	1	2	3	4	5
8. Document a nursing note.	1	2	3	4	5
9. Perform nursing interventions.	1	2	3	4	5
10. Determine nursing diagnoses.	1	2	3	4	5
11. Interpret diagnostic tests.	1	2	3	4	5
12. Interpret cardiac rhythms.	1	2	3	4	5
13. Interpret lab values.	1	2	3	4	5
14. Interpret vital signs.	1	2	3	4	5
15. Interpret central venous pressures.	1	2	3	4	5
16. Interpret pulmonary artery catheter values.	1	2	3	4	5
17. Interpret intracranial pressure values.	1	2	3	4	5
18. Identify patients in shock.	1	2	3	4	5
19. Treat patients in shock.	1	2	3	4	5
20. Interpret arterial blood gas values.	1	2	3	4	5

Developed by Robin A. Lewis © 2007

*Thank you for your time!*

## **APPENDIX C: PANEL OF EXPERTS**

### **Panel of Experts**

Dr. Sandra Bowles, EdD - Dean, Bert Bradford Division of Health Sciences, Division Chair, Department of Nursing, University of Charleston, Charleston, West Virginia.

Dr. Ronald B. Childress, EdD - Professor, Marshall University Graduate School of Education and Professional Development, South Charleston, West Virginia.

Dr. Laura Festa, EdD - Program Chair, Baccalaureate Science in Nursing Program, University of Charleston, Charleston, West Virginia.

Dr. Debra Kay Mullins, EdD - Associate Professor, Baccalaureate Science in Nursing Program, University of Charleston, Charleston, West Virginia.

Lisa Ramsburg, MSN - Assistant Professor of Nursing, Associate Degree in Nursing Program, St. Mary's Hospital, Huntington, West Virginia.

Dr. Paula Reilley, PhD - Associate Professor of Nursing, West Virginia State Community and Technical College, Institute, West Virginia

**APPENDIX D: PARTICIPANT LETTER WITH MARSHALL UNIVERSITY  
INSTITUTIONAL REVIEW BOARD APPROVAL**

Dear Student:

In an effort to learn more about the effects of the teaching strategies used in your medical surgical nursing course, please complete the attached survey. There are two sections to this survey. In the first part, respond to general questions about who you are. For the second part, rate your current competence level in medical surgical nursing practice. The purpose of the survey is to collect data for my dissertation research study.

This survey will take approximately 10 minutes to complete. Participation is voluntary and your consent is implied by your response. The information you supply is confidential. The results of the survey will be determined by the answers you provide and not by any personal information. Individual responses will not be identified. Data will be reported in aggregate form.

The results from this survey will assist in determining best educational strategies to use in teaching medical surgical nursing. If you have additional questions about the study, please contact me Robin Lewis at 304-357-4837 or by email at [robinlewis@ucwv.edu](mailto:robinlewis@ucwv.edu). If you have questions concerning your rights as a research participant, you may contact the Marshall University Office of Research Integrity at 696-4303.

Sincerely,

Robin A. Lewis, MSN, FNP-BC, CCRN, RN  
Graduate Student  
Marshall University Graduate College





**APPENDIX E: MARSHALL UNIVERSITY INSTITUTIONAL REVIEW BOARD  
APPROVAL**



Office of Research Integrity  
Institutional Review Board

Wednesday, August 20, 2008

Lisa A. Heaton, Ph.D.  
Education and Professional Development  
100 Angus E. Peyton Dr.  
South Charleston, WV. 25303

RE: IRB Study # EX09-0013    At: Marshall IRB 2

Dear Dr. Heaton:

**Protocol Title:**

Pre/Post Test and Survey Analysis of Virtual Human Patient Simulation Software in Nursing Education

**Expiration Date:** 8/19/2009

**Our Internal #:** 5121

**Type of Change:** (Other)

Exempted

**Expedited ?:** ☐

**Date of Change:** 8/20/2008

**Date Received:** 8/20/2008

**On Meeting Date:**

**Description:** In accordance with 45CFR46.101(b)(2), the above study and informed consent were granted Exempted approval today by the Marshall University IRB#2 for the period of 12 months. The approval will expire 8/19/09. A continuing review request for this study must be submitted no later than 30 days prior to the expiration date. This study is for student Robin Lewis.

The purpose of this study is to determine if virtual human patient gaming/simulation instruction has an effect on the learning outcomes of students in higher education medical surgical nursing education courses.

Respectfully yours,

Christopher W. LeGrow, Ph.D.  
Marshall University IRB #2 Vice Chair

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A State University of West Virginia • An Affirmative Action/Equal Opportunity Employer

## **CURRICULUM VITAE**

**ROBIN A. LEWIS**

### **EDUCATION**

Marshall University

**Doctor of Education in Curriculum and Instruction, EdD, 2009**

West Virginia University

**Master of Science in Nursing, 2002**

West Virginia University

**Bachelor of Science in Nursing, 1999**

University of Charleston

**Bachelor of Science in Biology, 1990**

University of Charleston

**Associate in Arts in Nursing, 1989**

### **CERTIFICATION**

American Academy of Nurse Practitioners, Family Nurse Practitioner, NP-C

American Association of Critical Care Nurses, Adult Critical Care Nursing, CCRN

American Heart Association, West Virginia Region, Basic Cardiac Life Support Provider

American Nurses Credentialing Center, Family Nurse Practitioner, FNP-BC

State of West Virginia, Department of Health and Human Services, Clinical Laboratory

Practitioner, Point of Care Technician

West Virginia Board of Examiners for Registered Professional Nurses, RN

### **PROFESSIONAL EXPERIENCE**

1989-1990	Staff Nurse, Relief Charge Nurse, Telemetry Unit, Saint Francis Hospital, Charleston, West Virginia
1990-1994	Staff Nurse, Relief Charge Nurse, Intensive Care Unit, Saint Francis Hospital, Charleston, West Virginia
1994	Shift Coordinator, West Virginia Dialysis Facility, Charleston, West Virginia
1994-1996	Director of Nursing, West Virginia Dialysis Facility, Charleston, West Virginia
1996	Telemetry Unit Shift Coordinator, Saint Francis Hospital, Charleston, West Virginia
1996-2001	Education Coordinator, Saint Francis Hospital, Charleston, West Virginia
1997	Interim Nurse Manager Telemetry Unit, Saint Francis Hospital, Charleston, West Virginia
1998-1999	Nurse Supervisor, Putnam General Hospital, Hurricane, West Virginia
1998-1999	Nurse Supervisor, Saint Francis Hospital, Charleston, West Virginia
1999-2000	Interim Chief Nursing Officer, Saint Francis Hospital, Charleston, West Virginia
2001-2002	Clinical Director Intensive Care Unit, Putnam General Hospital, Hurricane, West Virginia

2002-Present Assistant Professor of Nursing, Baccalaureate Nursing Department, University of Charleston, Charleston, West Virginia

2002-2004 Nurse Practitioner Trauma Services, Charleston Area Medical Center, Charleston, West Virginia

2002-2004 Nurse Practitioner Emergency Department Services, Charleston Area Medical Center, Charleston, West Virginia

2004-2006 Kaplan NCLEX-RN Teacher, Kaplan Inc., Louisville, Kentucky

2004-Present Nurse Practitioner, Women's Health Center, Charleston, West Virginia

2008-Present Nurse Practitioner, Medical Weight Loss Clinic of Charleston, Charleston, West Virginia

### **HONORS AND RECOGNITION**

1999 West Virginia University, Outstanding RN-BSN Student

2000 West Virginia Nurses Association, Legislative Leader

2000 West Virginia University, Clinical Preceptor

2001 West Virginia Nurses Association, State of West Virginia Health, Policy and Legislative Committee, Legislative Leader

2002 West Virginia University, Outstanding MSN Student

### **RESEARCH**

2000 A comparison of weight changes in older and younger persons undergoing CABG surgery. Funded by American Society for Parental and Enteral Nutrition, Rhodes Research Foundation, Richard Fleming Grant, \$5000.00. PI: R. DiMaria-Ghalili, PhD, RN, CNSN. Activities performed include data collection, and data base entry (Research Assistant)

2000 Post Operative Weight Loss & Depressive Symptoms in Older Elective CABG Patients. PI: R. DiMaria-Ghalili, PhD, RN, CNSN. Under supervision of the PI performed a review of literature, secondary data analysis of previously collected data on the unexplored relationship between the phenomena of depressive symptomatology and weight loss in older elective CABG clients (Research Assistant)

2000 Post-operative Weight Loss and Depressive Symptoms in Older Elective CABG Patients, Sixth National Nursing Research Conference, White Sulphur Springs, West Virginia. (Co-presenter, Poster).

2001 Post Operative Health Outcomes and Depressive Symptoms in Older Clients Recovering from Elective CABG Surgery, 2001: A Nursing Research Odyssey Alpha Rho Chapter of Sigma Theta Tau, Morgantown, West Virginia. (Co-presenter, Poster)

2001 Post Operative Health Outcomes and Depressive Symptoms in Older Clients Recovering from Elective CABG Surgery, West Virginia University-Charleston Division Research Division, (Co-presenter, Poster)

2002 Post Operative Health Outcomes and Depressive Symptoms in Older Clients Recovering from Elective CABG Surgery, 2002: A Nursing Research Odyssey

- Alpha Rho Chapter of Sigma Theta Tau, Morgantown, West Virginia. (Co-presenter, Poster)
- 2003 Concept Analysis of Well-Being, American Association of Critical Care Nurses Research Forum, Greater Charleston Area Chapter, Charleston, West Virginia (Presenter, Paper)
- 2003 Weight Loss and Depressive Symptoms During CABG Recovery  
2003: A Nursing Research Odyssey Alpha Rho Chapter of Sigma Theta Tau, Morgantown, West Virginia (Co-presenter, Paper)
- 2003 Weight Loss and Depressive Symptoms During CABG Recovery, Seventeenth Annual Conference of the Southern Nursing Research Society, Orlando, Florida. (Co-presenter, Poster)
- 2004 State of the Science of Well-Being, Eighteenth Annual Conference of the Southern Nursing Research Society, Louisville, Kentucky (Presenter, Poster)
- 2004 Weight Loss and Depressive Symptoms During CABG Recovery  
2004 Research Forum Xi Tau Chapter of Sigma Theta Tau, Charleston, West Virginia (Co-presenter, Paper)
- 2007 Technology Use and Professional Growth through the Residency Portfolio, Virtual Clinical Excursions: Practical Use of Gaming Simulation Software, Society for Information Technology & Teacher Education, San Antonio, Texas (Co-Panel Presenter)
- 2007 Virtual Clinical Excursions: Gaming and Simulation in Higher Education, 2007 West Virginia Statewide Technology Conference, Charleston, West Virginia (Presenter, Paper)
- 2007 Virtual Clinical Excursions: Gaming and Simulations in Nursing Education, Infusing Technology into Nursing Education, Association of Deans and Directors of Nursing Education Conference. University of Charleston, Charleston, West Virginia (Presenter, Paper).
- 2008 Online Teaching and Learning Panel – Q & A. Online Learning/Technology Conference. Saint Mary's Hospital, Huntington, West Virginia (Co-Panel Presenter).
- 2009 The Effects of Virtual Clinical Gaming Simulation on Student Learning Outcomes in Medical-Surgical Nursing Education Courses. Let the games Begin! 2009 Research Forum Xi Tau Chapter of Sigma Theta Tau, Charleston, West Virginia (Presenter, Paper)